

# Environmental Resources Management, Inc.

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101077

12 November 1991

Stephanie Dehnhard  
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FILE: C27-01-01

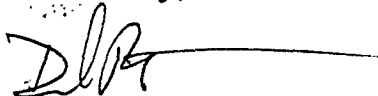
Dear Stephanie:

On behalf of Clark Equipment Company (Clark), Environmental Resources Management, Inc. (ERM) is pleased to submit the revised Work Plan for the Tyler Refrigeration Pit Superfund Site Remedial Investigation/Feasibility Study. This submittal is in accordance with Sections VIIID & VIIIE of the Administrative Order on Consent between Clark and the EPA. The revisions to the Work Plan reflect ERM's and Clark's conversations with EPA on 24 October 1991 and summarized in my correspondence of 29 October 1991.

I am sending you nine (9) copies of the Work Plan, including the Field Sampling Plan, and the Health and Safety Plan. Revised sections of the Quality Assurance Project Plan are also included. One copy is being sent directly to John Gysling of the Delaware Department of Natural Resources and Environmental Control. I have also included a copy of the Work Plan with revised portions noted in italicized type. We will also be sending additional materials to assist your review of ERM's and Clark's responses to your comments. As noted previously, the cover pages will be signed when the Work Plan is approved.

Please call me at 524-3526 if you have any questions or comments.

Sincerely,



David P. Steele  
Project Manager

DPS

Enclosures: (9) copies of Draft Work Plan for Tyler Refrigeration Pit Superfund Site Remedial Investigation/Feasibility Study (w/ Field Sampling Plan, Quality Assurance Project Plan and Health and Safety Plan)

cc: David Jones, Clark  
Al Funk, ERM

**RI/FS WORK PLAN  
TYLER REFRIGERATION PIT  
SUPERFUND SITE  
SMYRNA, DELAWARE**

12 November 1991

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**Alan Funk, P.G.  
Project Director**

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**David Steele  
Project Manager**

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Project Geologist**

Prepared For:  
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File No.: C27-01-01

AR300356



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- A Sampling and Analysis Plan
- B Health and Safety Plan



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## SECTION 1 INTRODUCTION

This Work Plan is being submitted by Environmental Resources Management, Inc. (ERM), on behalf of Clark Equipment Company, (Clark) which has entered into an Administrative Order on Consent (AOC) with the United States Environmental Protection Agency (EPA) to perform a Remedial Investigation/Feasibility Study (RI/FS) at the Tyler Refrigeration Pit Superfund Site (the "Site") in Smyrna, Kent County, Delaware.

The purpose of the RI is to characterize the geology and hydrogeology of the Site and determine the nature and extent of the release or threatened release, if any, of hazardous substances from the Site. The FS shall identify and evaluate alternatives for remedial action as may be necessary to prevent, mitigate or otherwise respond to the release or threatened release, if any, of hazardous substances at or from the Site.

The purpose of this Work Plan is to define the focus of the RI/FS and to delineate the specific tasks needed to conduct the RI/FS. All work will be conducted in accordance with the Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (U.S. EPA, October 1988). Other guidance documents to be followed are listed in Table 1-1.

**Table 1-1**  
**Guidance Documents for RI/FS**  
**Tyler Refrigeration Pit Superfund Site**  
**Smyrna, Delaware**

1. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA  
EPA/540/G-89/004  
OSWER 9355.3-01  
October 1988
2. CERCLA Compliance with Other Laws Manual  
EPA/540/G-89/006  
August 1988
3. CERCLA Compliance with Other Laws Manual: Part II; Clean Air Act and Other Environmental Statutes and State Requirements  
EPA/540/G-89/009  
OSWER Directive 9234.1-02  
August 1989
4. Risk Assessment Guidance for Superfund  
Volume I: Human Health Evaluation Manual (Part A)  
EPA/540/1-89/002  
December 1989
5. Risk Assessment Guidance for Superfund  
Volume II: Environmental Evaluation Manual  
EPA/540/1-89/001  
March 1989
6. Preparing Perfect Project Plans  
A Pocket Guide for the Preparation of Quality Assurance Project Plans  
EPA Risk Reduction Engineering Laboratory  
EPA/600/9-89/087  
October 1989
7. Data Quality Objectives for Remedial Response Activities  
EPA/540/G-87/003  
OSWER Directive 9355.0-7B  
March 1987

## **SECTION 2 SITE BACKGROUND**

### **2.1 Site Description and Setting**

#### **2.1.1 Location**

The Site is a former lagoon area located at 655 Glenwood Ave, Smyrna, Delaware (Figure 2-1). The Site is situated on a parcel of property that is currently occupied by Metal Masters Food Service Equipment Company, Inc. (Metal Masters), but was formerly owned by the Tyler Refrigeration Corporation. The Site is approximately 1/2 mile southwest of the center of the town of Smyrna (population 4750).

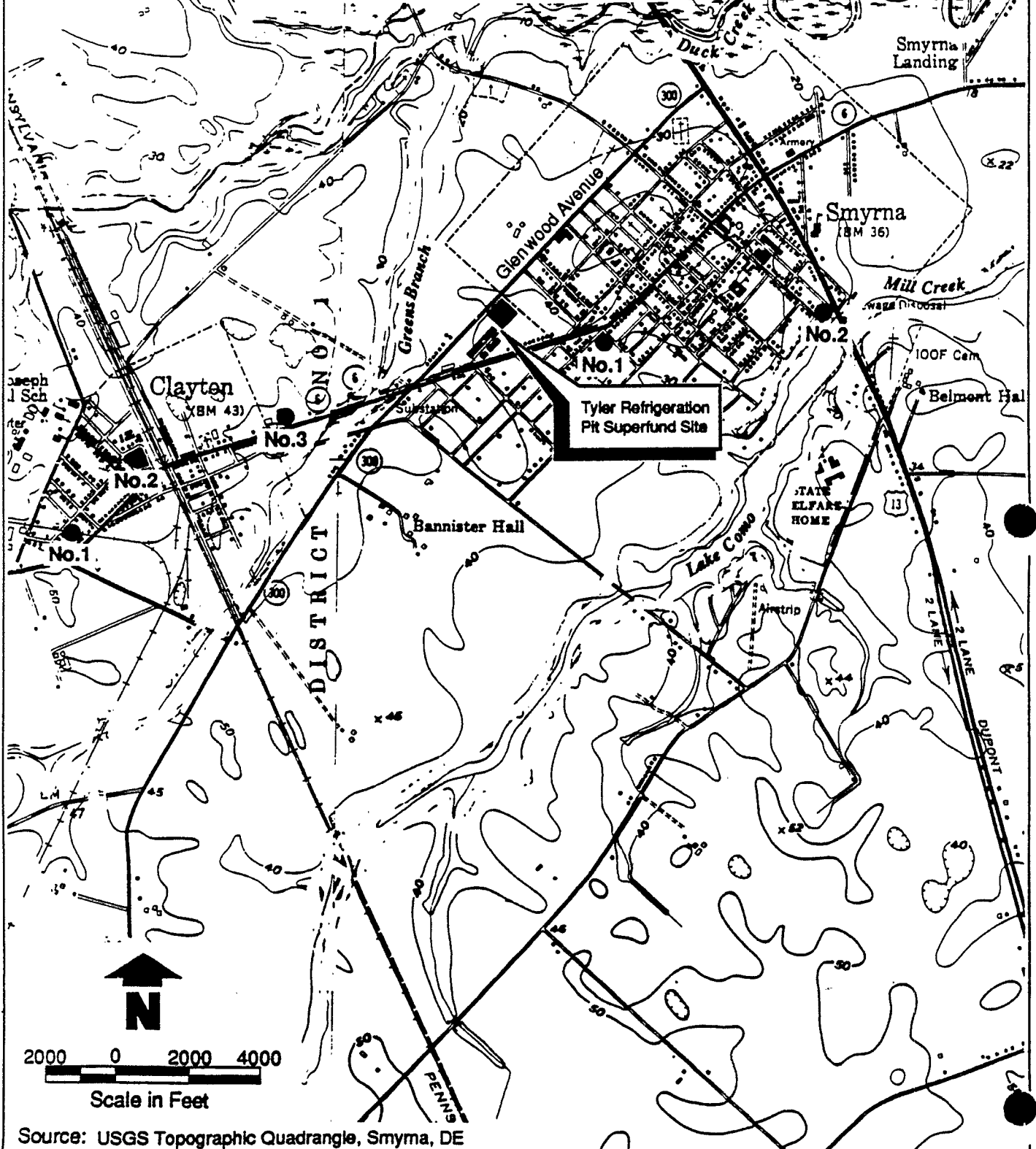
#### **2.1.2 Site Description**

The Site consists of an area which formerly contained two wastewater lagoons. The Site is located in the northeast portion of the Metal Masters property (Figure 2-2). Aerial photographs suggest that the northernmost lagoon was approximately 70 feet x 70 feet in size and the southernmost lagoon was approximately 60 feet x 60 feet. The depth of the lagoons is uncertain. The lagoons apparently received wastewater from manufacturing operations at the property.


Based on a review of aerial photographs, the two lagoons were present on the property from as early as July, 1954. This review also indicates that sometime between 1973 and 1975, the contents of the lagoons were excavated and removed. The lagoons were subsequently backfilled and regraded. The Site is currently covered by a lawn and an asphalt parking lot for the manufacturing building located on the property.

The land use in the area surrounding the Site is predominantly residential, with some light industry and farming. Properties to the north of the Site across Glenwood Avenue include an automotive body shop, a tavern and a motel, a former oil storage terminal, several residences, and agricultural lands. To the west-northwest of the Site are several residences along Glenwood Avenue. To the southwest and south of the Site is the Metal Masters building and a grain elevator/silo structure. The area to the south-southeast of the Site is mainly residential (Figure 2-3).

**Figure 2-1**  
**Site Location Map**  
**Tyler Refrigeration Pit**  
**Superfund Site**  
**Smyrna, Delaware**

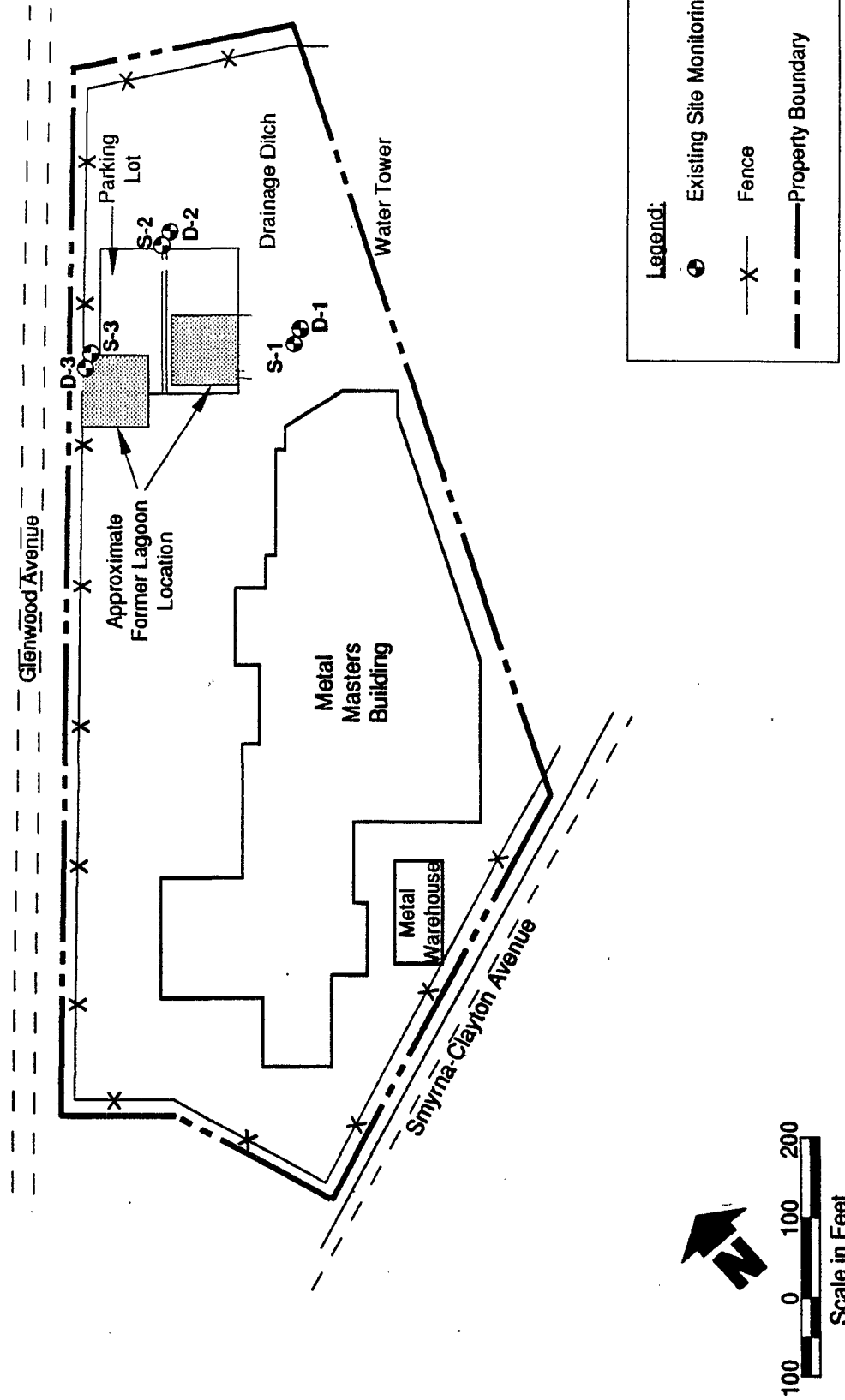


Source: USGS Topographic Quadrangle, Smyrna, DE

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**Figure 2-2**  
**Site Plan**  
 Tyler Refrigeration Pit Superfund Site  
 Smyrna, Delaware



Notes:

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Checked By / Date: E. Sullivan 11.12.91

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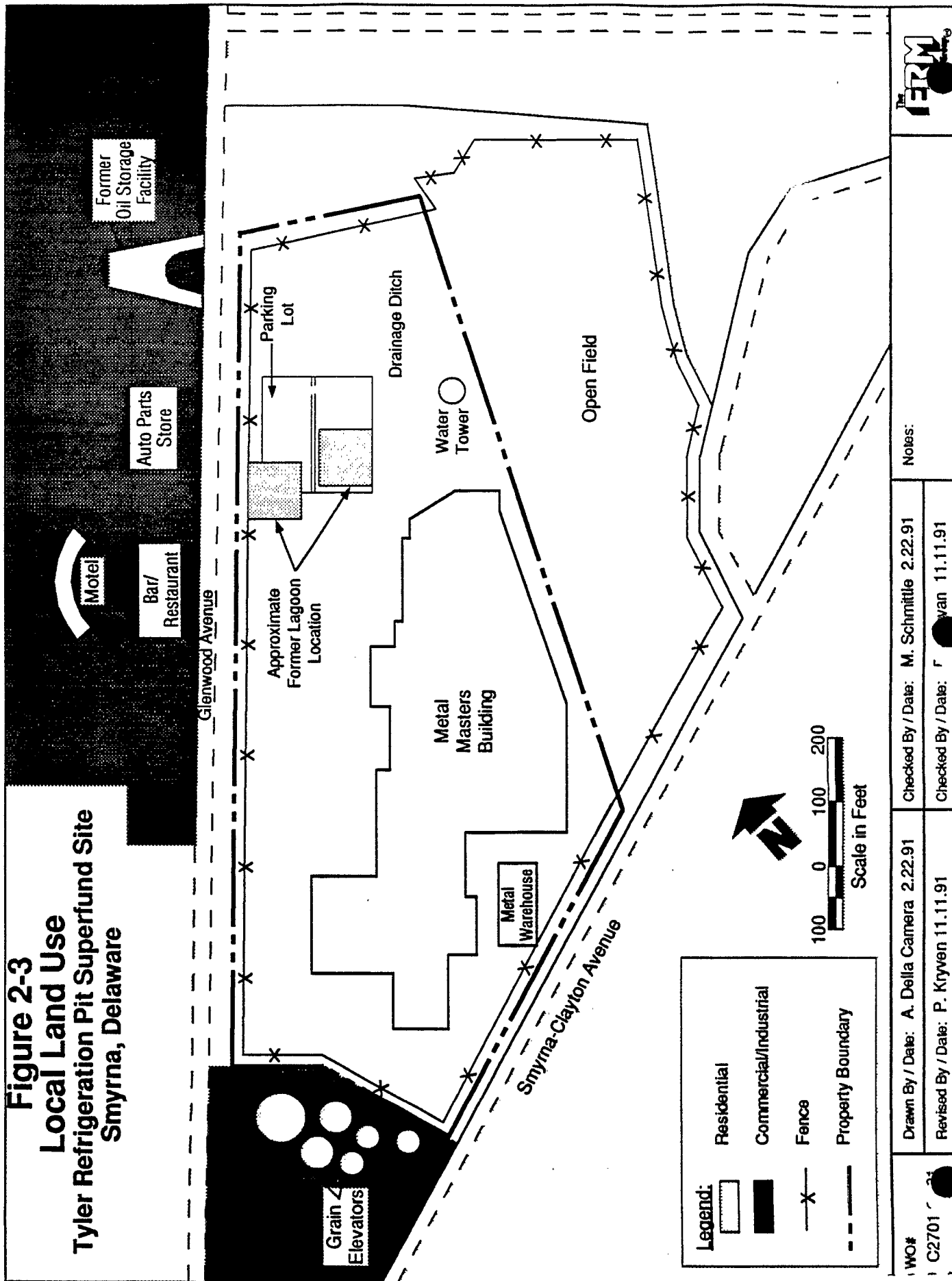
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**Figure 2-3**  
**Local Land Use**  
**Tyler Refrigeration Pit Superfund Site**  
**Smyrna, Delaware**



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### 2.1.3 Topography and Surface Drainage

The topography at the Site is nearly level. The entire Site is at an elevation of approximately 40 feet above sea level.

Surface drainage from the parking lot area at the Site is conveyed via storm drains to a shallow drainage ditch with no outlet, located just east of the Site.

Surface water bodies in the general area include Greens Branch, Duck Creek, Lake Como, and Mill Creek (Figure 2-1). Greens Branch is a tributary of Duck Creek. It is located approximately 1500 feet west of the Site and flows in a northeasterly direction into Duck Creek. Duck Creek is located approximately 4000 feet to the north of the Site and flows east to its confluence with the Smyrna River. Lake Como is located approximately 4000 feet to the southeast of the Site. It was formed behind a dam on Mill Creek. Mill Creek flows in a easterly to northerly direction to its confluence with the Smyrna River. The Smyrna River flows to the northeast and discharges to the Delaware Bay. Wetlands occur along Duck Creek, Mill Creek and the Smyrna River.

The Smyrna River is used for industrial and agricultural water supply, for recreational purposes and as a habitat for fish and wildlife. Lake Como is used for recreational purposes.

### 2.1.4 Regional Geology/Hydrogeology and Soils

#### 2.1.4.1 Geology

The Site lies within the Atlantic Coastal Plain physiographic province. The sedimentary beds of this province dip gently to the southeast and consist of a wedge of sedimentary deposits thickening down-dip (Figure 2-4). This sedimentary wedge is approximately 2,200 feet thick in northwest Kent County (*Picket and Benson, 1977*).

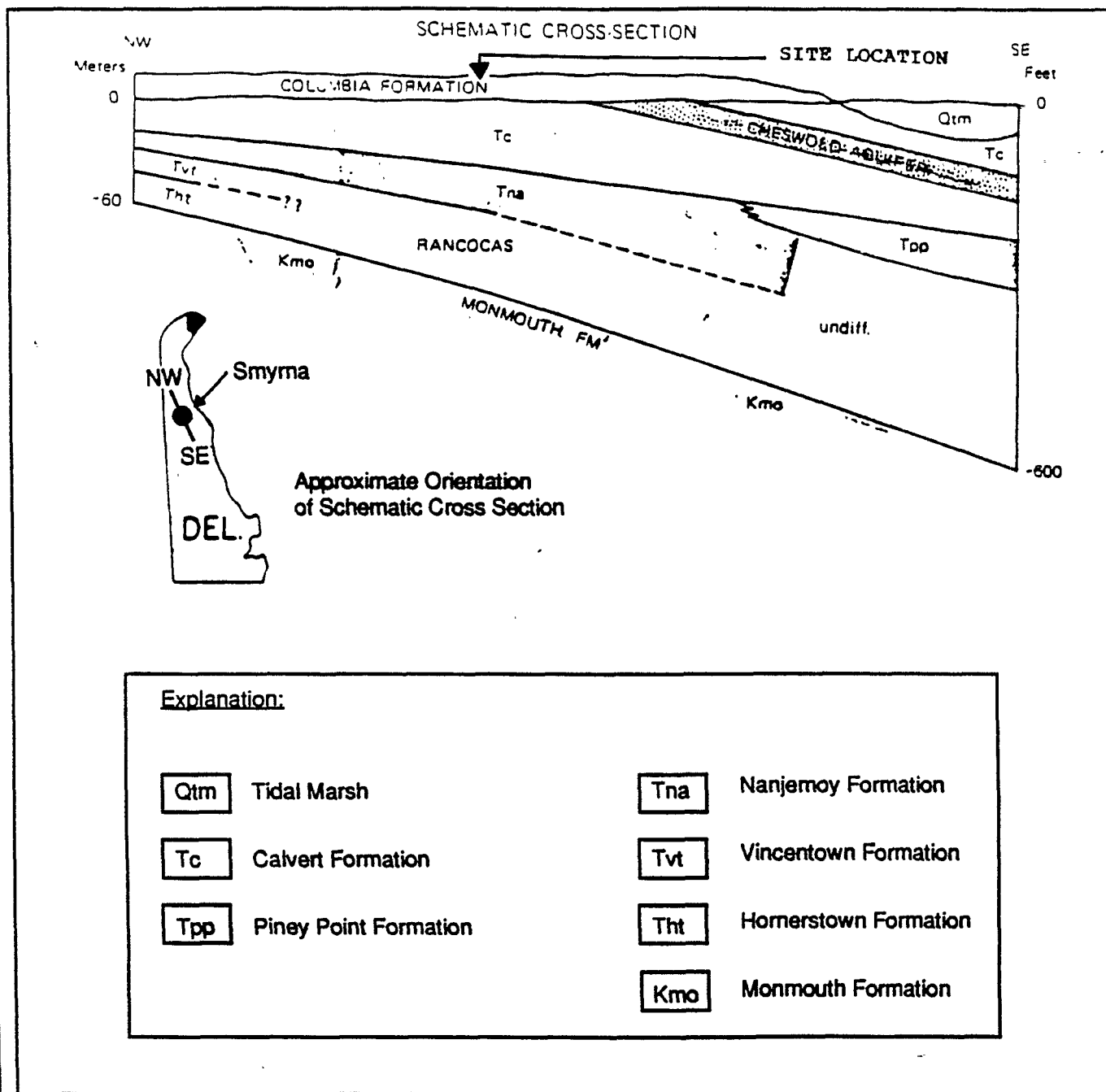
Directly underlying the Site are sediments of the Pleistocene-aged Columbia Formation. The Columbia Formation sediments consist mostly of fine to coarse grained quartz sand with some gravel, and occasional thin silt beds. The Columbia sediments were deposited by fluvial processes and are variable in thickness. Some areas of greater thickness occur in a few regional troughs, which may have contained former stream channels or groups of stream channels. One such trough extends southeastward from Smyrna (Figure 2-5) (*Johnston, 1973*).

# Figure 2-4

## Geology of the Smyrna-Clayton Area

### Tyler Refrigeration Pit Superfund Site

### Smyrna, Delaware

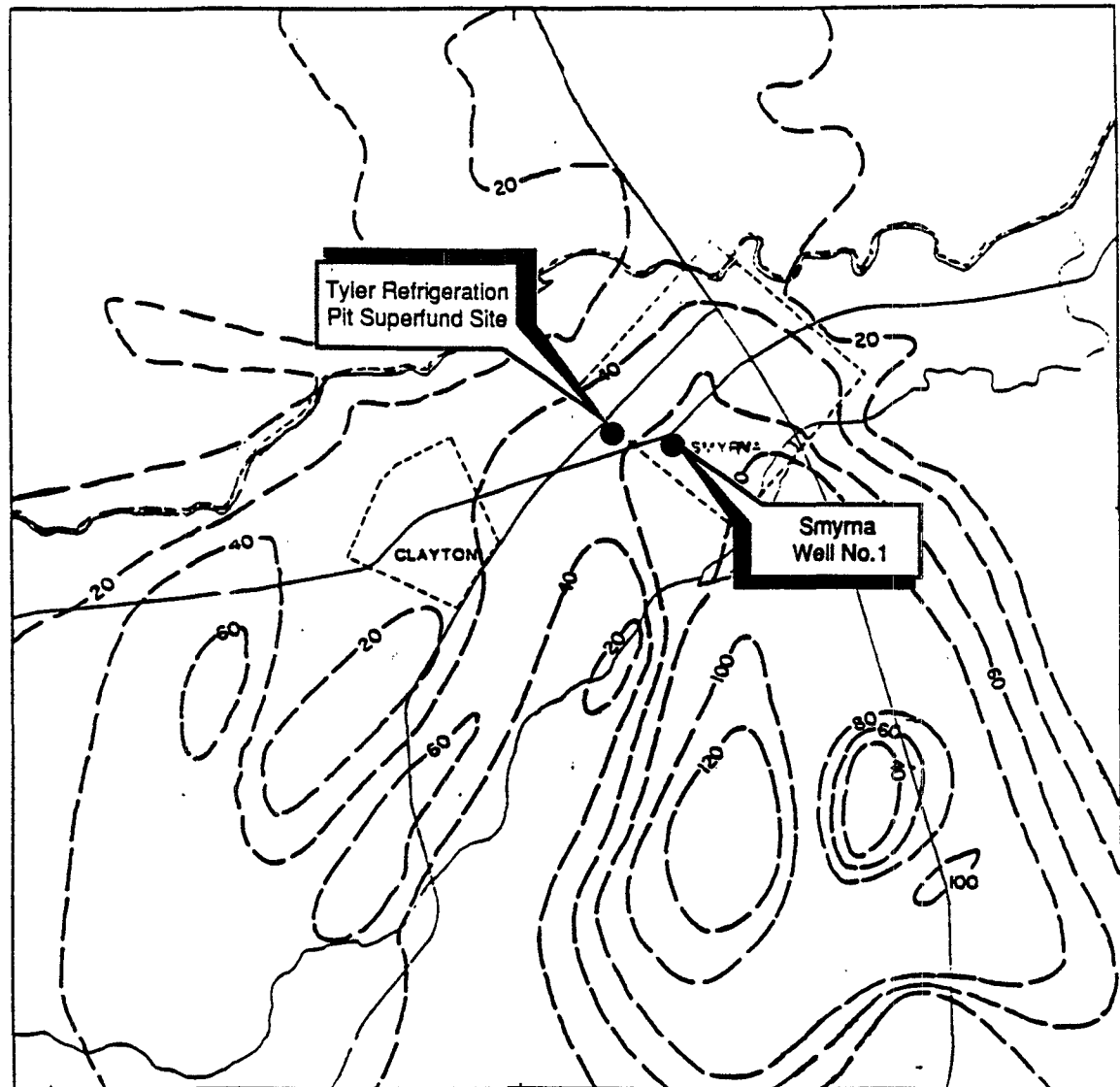


Source: "Geology of the Smyrna-Clayton Area, Delaware"  
by Thomas E. Pickett and Richard N. Benson

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	Revised by / Date: P. Kryven 11.12.91	Checked by / Date: E. Sullivan 11.12.91	

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# Figure 2-5 Saturated Thickness of The Columbia Formation Tyler Refrigeration Pit Superfund Site Smyrna, Delaware



Approximate Scale in Miles

Source: Hydrogeology of the Smyrna-Clayton Area, Cherry, Phillip John, 1983

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Underlying the Pleistocene sediments of the Columbia Formation are the Miocene age sediments of the Chesapeake Group. The Chesapeake Group consists mainly of gray to bluish-gray silt that contains some gray, fine to medium grained sand. These fine grained sediments may act as an aquitard, limiting the vertical flow of ground water. The Cheswold aquifer is a sand unit within the Calvert Formation of the Chesapeake Group. The Cheswold aquifer subcrops approximately 1,400 feet southeast of the Site.

Underlying the Chesapeake Group is the Nanjemoy Formation. This formation consists of greenish-gray glauconitic silt with some sand. Beneath the Nanjemoy Formation lies the Hornerstown and Vincentown Formations of the Rancocas Group. These formations consist of a greenish-gray sand with some silt. Underlying the Rancocas Group are the Cretaceous Matawan and Monmouth Formations, and the Magothy Formation. The Coastal Plain sediments lie unconformably on top of the pre-Cambrian-age crystalline bedrock (Picket and Benson, 1977).

#### 2.1.4.2 Hydrogeology

The Columbia Formation sediments underlying the Site form a productive regional water table aquifer. The average transmissivity of the Columbia aquifer in central and southern Delaware is 7,000 ft<sup>2</sup>/day. An area of higher transmissivity (greater than 20,000 ft<sup>2</sup>/day) is associated with the trough that extends south from Smyrna. The higher transmissivity is a result of an increase in the saturated thickness of the aquifer (Johnston, 1973).

#### 2.1.4.3 Soils

The soil survey for Kent County, Delaware maps the soils underlying the Site as Sassafras sandy loam with a 2-5% slope. The Sassafras series are deep well drained soils formed in very old, predominantly sandy sediments. A typical profile consists of an 11-inch A horizon of sandy loam. Underlying that is a 22-inch B horizon generally of sandy clay loam but in some places loam or heavy sandy loam. The 21-inch C horizon is sand or loamy sand (Soil Survey of Kent County Delaware 1971).

#### 2.1.5 Water Supply

A preliminary review of water use in the area surrounding the Site indicates that potable water supplies are obtained entirely from

ground water, and are provided primarily through municipal water systems. The City of Smyrna operates two public water supply wells. Well No. 1 is located approximately 1600 feet east of the Site, and Well No. 2 is located approximately 4600 feet east of the Site. The City of Clayton operates three public water supply wells. The closest of these wells to the Site is Well No. 3 which is located approximately 3300 feet southwest of the Site. Clayton Wells No. 1 and No. 2 are both located greater than 1 mile southwest of the Site. All three Clayton wells are located in the upgradient ground water flow direction from the Site. The Town of Smyrna wells draw water from the Columbia Formation aquifer while the Clayton wells all draw water from the deeper Rancocas aquifer. In the Smyrna area, the Columbia and Rancocas aquifers are separated by the Calvert and Nanjemoy formations. These formations are 200 feet thick in the Smyrna area, and act as a confining unit above the Rancocas aquifer. Available pump test data indicates that the Rancocas aquifer is tightly confined. Direct recharge of the Rancocas aquifer in the Smyrna-Clayton area via downward vertical leakage is considered negligible (Cherry 1983). The available Smyrna and Clayton well information is summarized in Table 2-1. The majority of domestic wells in the area would be expected to draw water from the Columbia Formation aquifer.

## 2.2 Site History

Little is known regarding the uses of the Site and surrounding property prior to 1946. In 1946, however, the property which includes the Site was sold by John E. Wilson, Jr. and Bertha M. Wilson to the Wilson Cabinet Company, Inc. In 1949, Wilson Cabinet Company merged into Wilson Refrigeration, Inc. A plant was apparently constructed on the property during this time period to manufacture refrigerators.

In 1951, Tyler Refrigeration Corporation (Tyler) assumed control of the refrigeration manufacturing operations at the property. The Wilsons again took title to property in 1951 from Wilson Refrigeration, Inc. and leased the property to Tyler until 1956 when title to the property passed to Tyler.

According to aerial photographs, sometime prior to July 1954, two lagoons were constructed in the northeast portion of the property. These lagoons were apparently constructed to receive wastewater from the manufacturing operations at the property although no records are available as to their operation.

Validated Site?

7/5/54

**Table 2-1**  
**Smyrna and Clayton Municipal Well Data**  
**Tyler Refrigeration Pit Superfund Site**  
**Smyrna, Delaware**

Well Number	Date Drilled	Depth (Feet)	Diameter (Inches)	Screened Interval (Feet)	Aquifer	Capacity (Gallons/Minute)
Smyrna	1948	100	10	80-95	Columbia	850
	1957	104	12	55-83 88-96	Columbia	1000
Clayton	1953	276	10	235-272	Rancocas	350
	1968	270*	10	230-270	Rancocas	300
	1976	330	10	237-320	Rancocas	300

Source: "A Follow-up Site Inspection of Tyler Refrigeration"  
 Prepared by Delaware Department of Natural Resources and Environmental Control (DNREC)

\*DNREC's Table listed depth as 230 feet but screened interval as 230-270.

In 1963, Tyler transferred the property to Clark as part of a transaction whereby Tyler became a part of the refrigeration division of Clark. Clark manufactured refrigeration-related equipment at the property until approximately 1976.

According to NUS ("A Field Report for Tyler Refrigeration" 1986), wastewater discharges from manufacturing operations were connected to a municipal sewage system in 1969. In addition, aerial photographs indicate that sometime between 1973 and 1975, the contents of the lagoons were excavated and removed. Lagoon materials and or soils were reportedly removed to a depth of approximately 20 feet.

In 1978, the property was purchased from Clark by Metal Masters. Pursuant to a financing arrangement with Metal Masters in connection with this transaction, the Delaware Department of Community Affairs and Economic Development took title to the property. Metal Masters has been manufacturing food service equipment at the property since 1978.

### 2.3 Previous Investigations

In 1977 during routine monitoring, the Town of Smyrna's two municipal water supply wells were found to contain trichloroethene (TCE), at concentrations of 30 to 50  $\mu\text{g/L}$  (parts per billion or ppb). Shortly after the presence of TCE was confirmed in the Smyrna municipal wells, the Delaware Department of Natural Resources and Environmental Control (DNREC), *the Delaware Division of Public Health and the Town of Smyrna (Joyce 1984)*, conducted an investigation to identify possible sources of TCE. *This investigation identified numerous potential sources of TCE in the Smyrna area including the Site and concluded that numerous sources had potentially contributed to the TCE found in Smyrna's wells (Joyce, 1984)*

In 1982, Smyrna installed Granular Activated Carbon (GAC) units on its two municipal water supply wells. The GAC units effectively reduced TCE concentrations in finished water supplies to below analytical detection limits.

Notwithstanding the installation of GAC units on Smyrna's municipal wells, in 1982, EPA commissioned Ecology and Environment, Inc. ("E&E") to perform a Preliminary Assessment/Site Investigation in connection with the Site. This study included the collection of three shallow soil samples (1 to 2 feet) in an area where the former lagoons



were judged to have been located (as shown in Figure 2-6), residential and municipal well sampling, and interviews with former Tyler employees. All samples were analyzed for Hazardous Substance List (HSL) volatile organics (VOAs), semi-volatile organics (SVOAs) (*base/neutral and acid extractable compounds*), pesticides/PCBs, dioxin and metals. The findings of that study are summarized in a report entitled "Preliminary Assessment and Site Inspection of Tyler Refrigeration" (October 28, 1982). According to laboratory data sheets, 1,1,1-trichloroethane (TCA) and 1,1-dichloroethane (DCA) were detected in one of the soil samples at concentrations of 15 micrograms per kilogram ( $\mu\text{g/Kg}$  or parts per billion) and 10  $\mu\text{g/Kg}$  respectively. Toluene was detected in a second soil sample at a concentration of 25  $\mu\text{g/Kg}$ . These results were erroneously reported in units of parts per million in the text of the report and in the attached Potential Hazardous Waste Site Identification and Preliminary Assessment Form.

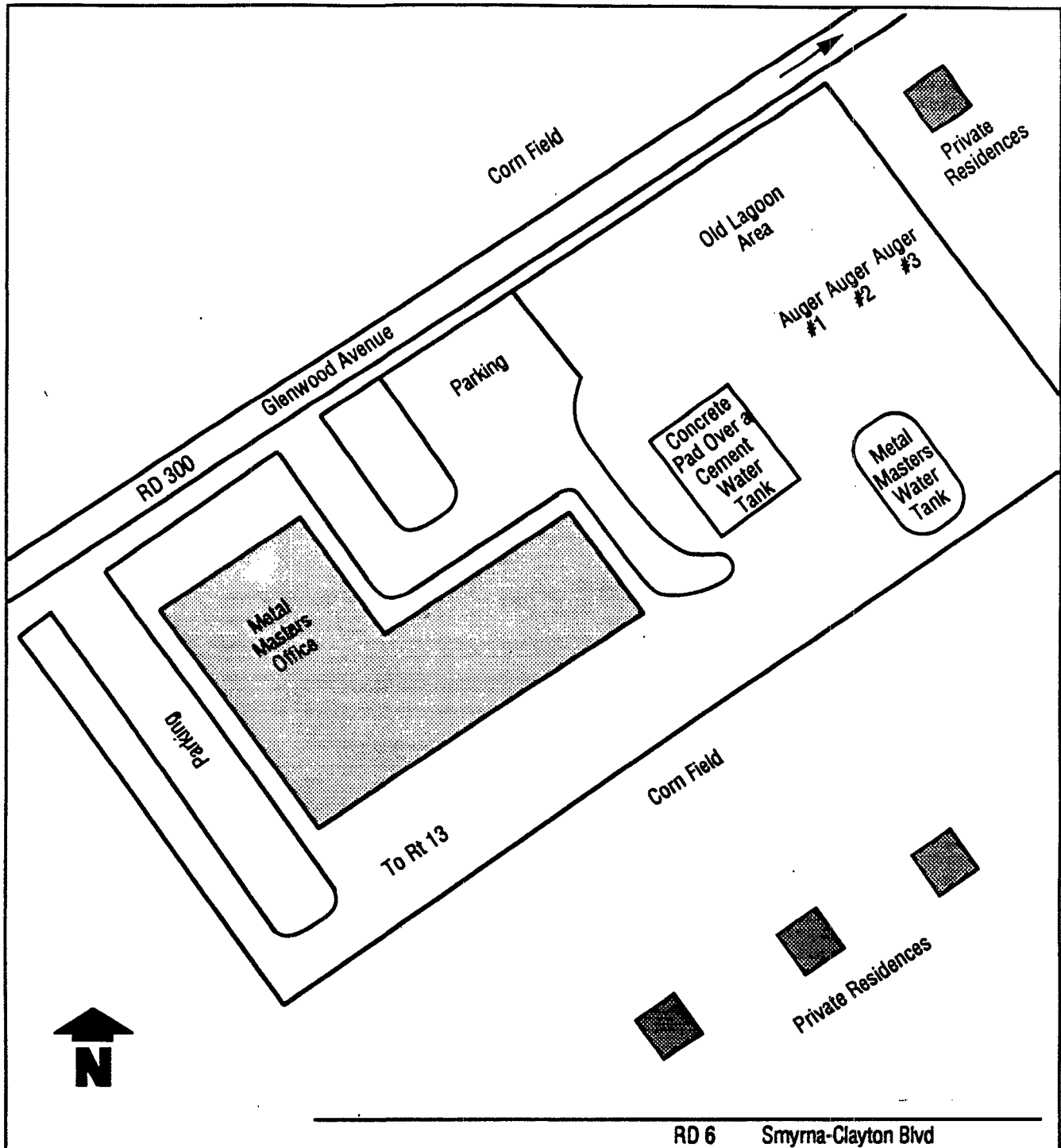
Thereafter, DNREC performed a "Preliminary Site Assessment of Tyler Refrigeration" in December 1983. This report concluded that since TCE concentrations in the Smyrna water supply wells appeared to be decreasing, and the water treatment system was eliminating TCE from drinking water supplies, no further action was necessary at that time.

In 1984, Mr. Michael Joyce of the Delaware Division of Public Health analyzed potential sources of TCE in the Smyrna area in a paper entitled "Trichloroethylene Ground Water Contamination in Smyrna, Delaware." In that report, a total of 17 potential TCE sources were identified, including seven active TCE users, five previous TCE users (including Tyler Refrigeration), and five municipal dump sites.


The following year NUS Corporation prepared in connection with the Site a "Potential Hazardous Waste Site Inspection Report" dated May 23, 1985. NUS also prepared a "Non-Sampling Site Inspection Using Available Information Report" dated June 10, 1985. That report concluded that based on available information, the Site might only be one of several possible sources of the TCE found in the Smyrna municipal wells.

During the summer of 1985, EPA evaluated the Site under the Hazard Ranking System (HRS) for possible inclusion on the National Priorities List (NPL). EPA based its evaluation on the data collected and improperly reported by E&E in 1982. EPA ultimately determined that the Site scored 29.41 under the HRS, and on June 10, 1986, formally proposed to add the Site to the NPL. The HRS score for the Site was

**Figure 2-6**  
**Previous Soil Sample Locations**  
 Tyler Refrigeration Pit Superfund Site  
 Smyrna, Delaware



Source: "Preliminary Assessment and Site Inspection of Tyler Refrigeration"  
 Prepared by Ecology and Environment, Inc. (EEI)

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based on the potential release of hazardous substances to ground water. The erroneous concentrations of TCA, DCA and toluene in soil presented in the 1982 E&E report were referenced in the HRS scoring document.

On May 7, 1986, NUS collected a total of 10 ground water samples from domestic wells in the vicinity of the Site. The samples were analyzed for HSL volatile organic compounds and the sampling results reported in "A Field Trip Report for Tyler Refrigeration" prepared by NUS and dated August 15, 1986. Only low levels of chloroform were detected in two of the samples.

Following consideration of comments submitted by Clark concerning EPA's proposal to add the Site to the NPL, EPA commissioned DNREC to conduct a further investigation at the Site. In 1988, DNREC performed a Follow-Up Site Inspection at the Site. The results of this study were summarized in a draft report entitled "Follow-up Site Inspection of Tyler Refrigeration" (undated). This study included the installation and sampling of six monitoring wells surrounding the Site to assess whether substances of concern were present in ground water beneath the site and to establish and the direction of ground water flow at the Site. Monitoring well nests were installed at three locations in January of 1988 (Figure 2-2). Each well nest consisted of a shallow well screened at the top of the water table aquifer, and a deep well screened at the base of the aquifer. Well construction details are summarized in Table 2-2. *Table 2-2 also summarizes the well construction details of the six monitoring wells located at a former oil storage facility across Glenwood Avenue from the Site. Information from these monitoring wells was used to construct a water table contour map (see Section 2.4).*

On May 17, 1988, DNREC collected ground water samples from the newly installed wells. The samples collected by DNREC were analyzed for Target Compound List (TCL) VOAs, SVOAs, pesticides/PCBs, and Target Analyte List (TAL) metals, in accordance with EPA Contract Laboratory Program (CLP) procedures. *EPA performed data validation on the analytical results of this investigation, the results of which were included in the follow-up site inspection report.* Based on the ground water sampling results, the three substances of concern that were identified in connection with the Site (as listed in the Summary Statement of Work) were 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethene (1,1-DCE) and chromium. 1,1,1-TCA was detected in each of the three shallow wells at concentrations ranging from 5 to

**Table 2-2**  
**Well Construction Details**  
**Tyler Refrigeration Pit Superfund Site**  
**Smyrna, Delaware**

<b>Well Number</b>	<b>Measuring Point Elevation (Feet MSL)</b>	<b>Diameter (Inches)</b>	<b>Total Depth (Feet)</b>	<b>Screened Interval (Feet)</b>
<b>On-site Wells</b>				
S-1	45.06	2	39	26.5-36.5
S-2	41.49	2	35	23-33
S-3	41.77	2	35	23-33
D-1	44.95	2	67.5	55-65
D-2	41.27	2	54	42-52
D-3	42.10	2	56	44-54
<b>Off-site Wells</b>				
MW-1	38.63	4	30	13-28
MW-2	39.84	4	30	13-28
MW-3	39.31	4	30	13-28
MW-4	39.02	4	30	13-28
MW-5	41.01	4	30	13-28
MW-6	39.90	4	30	13-28

Source for on-site well construction: "Follow-up Site Inspection of Tyler Refrigeration" prepared by Delaware Department of Natural Resources and Environmental Control (DNREC)  
Source for off-site well construction: a segment of report (title unknown) prepared by Groundwater Technology Inc. (date unknown), furnished by Mr. Larry N. McAllister.

110 micrograms per liter ( $\mu\text{g/L}$ ), 1,1-DCE was detected in well S-1 at a concentration of 8  $\mu\text{g/L}$ , and chromium (total) was detected in wells S-2 and D-2 at concentrations of 19 and 113  $\mu\text{g/L}$ , respectively. Analytical results for 1,1,1-TCA, 1,1-DCE and chromium from DNREC's 1988 investigation and E&E's Preliminary Assessment are summarized in Table 2-3.

In April 1989, Dames & Moore conducted an investigation on behalf of Clark to evaluate the direction of ground water flow at the Site. Continuous water level data were collected in the three shallow wells surrounding the Site for a period of eight days. Dames & Moore concluded in a letter report dated May 2, 1989, that ground water flow at the Site was to the northeast, and that the direction of ground water flow did not appear to be affected by the pumping of the two Smyrna municipal wells.

Using the ground water sampling data collected by DNREC, EPA revised the HRS score for the Site, increasing the score to 33.94 based on an observed release theory. An observed release is deemed to have occurred when a substance of concern is measured at significantly higher levels in wells downgradient of a presumed source than in background wells. EPA concluded that an observed release had occurred because TCA concentrations at the Site were greater in wells S-1 and S-2 than in well S-3. Thereafter, on February 21, 1990, EPA formally added the Site to the NPL.

#### 2.4 Site Geology/Hydrogeology

Based on drilling logs from the six existing monitoring wells surrounding the Site, the Columbia Formation sediments below the Site range in thickness from 52 feet at well location D-2 to 65 feet at well location D-1. These sediments consist of fine to coarse grained sands and gravel. A black to brown-tan-gray silt or clay layer is present below the sand and gravel deposits. This layer most likely represents the upper portion of the Chesapeake Group and may act as an aquitard at the bottom of the Columbia Formation.

Available information suggests that the Columbia Formation sediments are approximately 95 feet thick at the location of Smyrna Well No. 1, 1600 feet east of the Site. This thickening of sediments is most likely a result of the southeast trending trough in the Smyrna vicinity, which was discussed in Section 2.1.4.

*not indicated*  
→ Columbia 52-65' at Site  
→ Chesapeake Group is below  
The ERG Group

**Table 2-3**  
**Soils and Ground Water Analytical Data From Prior Investigations**  
**Tyler Refrigeration Pit Superfund Site**  
**Smyrna, Delaware**

Soils concentrations reported in µg/kg. Ground water concentrations reported in µg/l.

Substance	Soil Samples			Ground Water Samples					
	A-1	A-2	A-3	S-1	S-2	S-3	D-1	D-2	D-3
<b>Volatile Organic Compounds</b>									
Methylene Chloride				9 B	8 B	10 B	7 B	9 B	7 B
Acetone	NA	NA	NA			6 B			
1,1-Dichloroethene				8					
1,1-Dichloroethane	10								
2-Butanone	NA	NA	NA	14 B			22 B		
1,1,1-trichloroethane	15			110	24	5			
Trichloroethene				4 J					
Tetrachloroethene				4 B	4 B	2 B	5 B	1 B	1 B
Toluene		25							
<b>Semi Volatile Organics</b>									
N-Nitrosodiphenylamine				5 B		5 B			4 B
bis(2-Ethylhexyl)phthalate				14 B	14 B	15 B	8 B	6 B	15 B
1,4-Dichlorobenzene									5 B
<b>Pesticides/PCB's</b>									
Heptachlor						0.068 B		0.051 B	
Dieldren						0.094 J		0.24	
<b>Inorganics (total)</b>									
Aluminum	140000	420000	720000	193 B	1010		465 B		224 B
Arsenic						3.5		3.5	
Barium	18000		20000	66 B	186 J	351 J	75 B	74 B	71 B
Boron		12000	11000	NA	NA	NA	NA	NA	NA
Cadmium									
Calcium	NA	NA	NA	14300	14400	18900	1580	4500	6660
Chromium				4.1 B	19	15 B	5.2 B	113	4.4 B
Iron				90 B	1040	109 B	312 B	79 B	85 B
Lead	3600	3700	1500	2.4 B	4.8 B	3.5 B	3.7 B	3.6 B	3.6 B
Magnesium	NA	NA	NA	10200	9060	6280	25000	2690	2620
Manganese	86000	33000	8000	48	10 B	9.3	133	46	60
Mercury							0.2		
Potassium	NA	NA	NA	1390	5180	8540	4010	2510	2430
Selenium				3.4	2.3	1.5		1	
Silver							0.8 B		
Sodium	NA	NA	NA	9500 B	8190 B	11700 B	7320 B	20200 B	8380 B
Zinc	5400	2800	2200	186 B	175 B	182 B	207 B	169 B	222 B

B- Not detected substantially above the level reported in laboratory or field blanks

J- Quantitative estimate.

NA- Not Analyzed

→ Blank space indicates the substance was not detected

Source of soils analytical data: "Preliminary Assessment and Site Inspection of Tyler Refrigeration" (October 28, 1982)

Samples Collected on June 30, 1982 by E&E

Source of ground water analytical data: "A Follow-Up Site Inspection of Tyler Refrigeration"

prepared by Delaware Department of Natural Resources and Environmental Control (DNREC)

Samples collected on May 17, 1988 by DNREC

Ground water occurs under unconfined water table conditions below the Site. Depth to water measurements *obtained* in the monitoring wells surrounding the Site by ERM on May 17 and May 31, 1991, show that the water table is approximately 22 feet below the land surface. Water level measurements were also *obtained* in six monitoring wells located at a former oil storage facility site across Glenwood Avenue to the north of the Site ("off-site wells"). As shown on Table 2-2, the screened intervals for the offsite wells are comparable to those of the shallow site wells, i.e., at the top of the water table, thus allowing the use of the data for water level evaluation at the Site. All of the monitoring wells were then surveyed by a Delaware licensed surveyor with respect to elevation and horizontal position. Table 2-4 summarizes the water level data obtained by ERM during May 1991. The water level measurements from both sets of wells were used to construct a water table contour map. Based on these water level measurements, ground water flow beneath the Site is to the northeast (Figure 2-7).

## **2.5 Preliminary Site Conceptual Model/Potential Migration Pathways**

In developing a technical scope of work for the Site, ERM has used the existing data base, a visit to the area, and the recent water level readings to develop a preliminary conceptual model of the former lagoon area and the natural systems that are present. This conceptual model defines the potential pathways for migration of constituents from the Site, based on the nature of apparent past activities, topography, surface drainage, subsurface geology, and ground water conditions at the Site. Possible exposure points for potential receptors have been identified based on demographic information. The technical scope of work has been developed to examine the potential migration pathways thus identified and to define actual exposures, if any.

A schematic conceptual model of the Site is shown in Figure 2-8. The Site is covered by an asphalt parking lot and lawn. A veneer of soil is present at the surface, overlying approximately 52 to 65 feet of coarse grained sediments of the Columbia Formation. The ground water table is located about 20 to 22 feet below the ground surface. Ground water flow is to the northeast. The topography surrounding the Site is relatively level and grass covered. No surface water bodies are nearby (the nearest surface water body is Greens Branch located 1500 feet to the west) *but not in the apparent direction of ground water flow from*

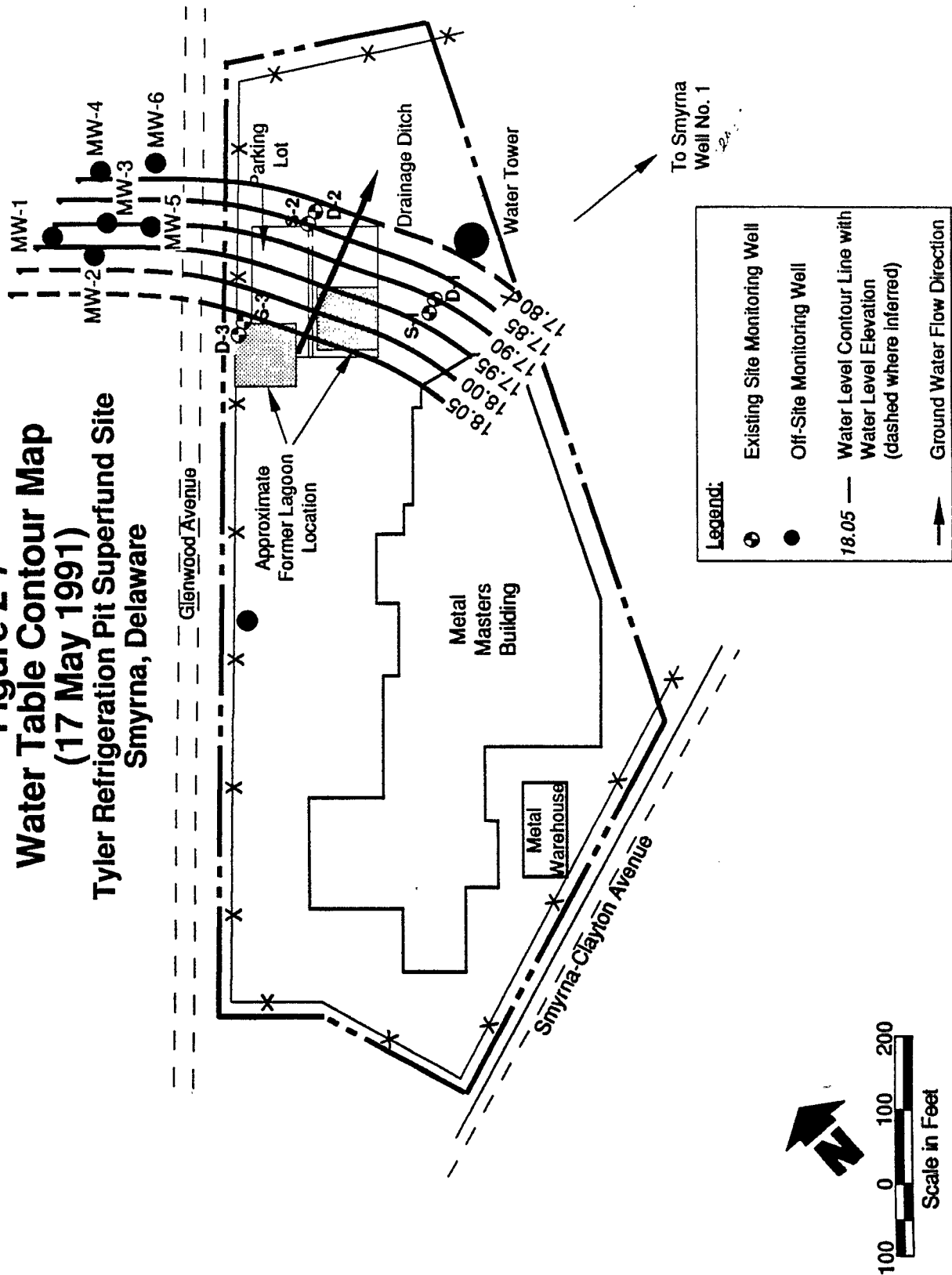
**Table 2-4**  
**Water Level Data**  
**17 May and 31 May 1991**  
**Tyler Refrigeration Pit Superfund Site**  
**Smyrna, Delaware**

Well Number	Measuring Point Elevation (Feet MSL)	Depth to Water		Water Level Elevation	
		17-May-1991 (Feet)	31-May-1991 (Feet)	17-May-1991 (Feet MSL)	31-May-1991 (Feet MSL)
On-site Wells					
S-1	45.05	27.12	27.25	17.93	17.80
S-2	41.47	23.64	23.77	17.83	17.70
S-3	41.76	23.67	23.81	18.09	17.95
D-1	44.94	27.02	27.15	17.92	17.79
D-2	41.26	23.44	23.58	17.82	17.68
D-3	42.08	23.98	24.12	18.10	17.96
Off-site Wells					
MW-1	38.67	20.74	20.87	17.93	17.80
MW-2	39.87	21.89	22.03	17.98	17.84
MW-3	39.32	21.43	21.57	17.89	17.75
MW-4	39.04	21.23	21.37	17.81	17.67
MW-5	41.03	23.13	23.25	17.90	17.78
MW-6	39.91	22.16	22.29	17.75	17.62

Note: Elevation data supplied by James Stewart Inc. (May 1991). This data may differ slightly from that given in Table 2-3. Source of elevation data in that table was DNREC report titled "Follow-up Site Inspection of Tyler Refrigeration"  
Off-site wells are located at a former oil storage facility across Glenwood Avenue to the north of the site.

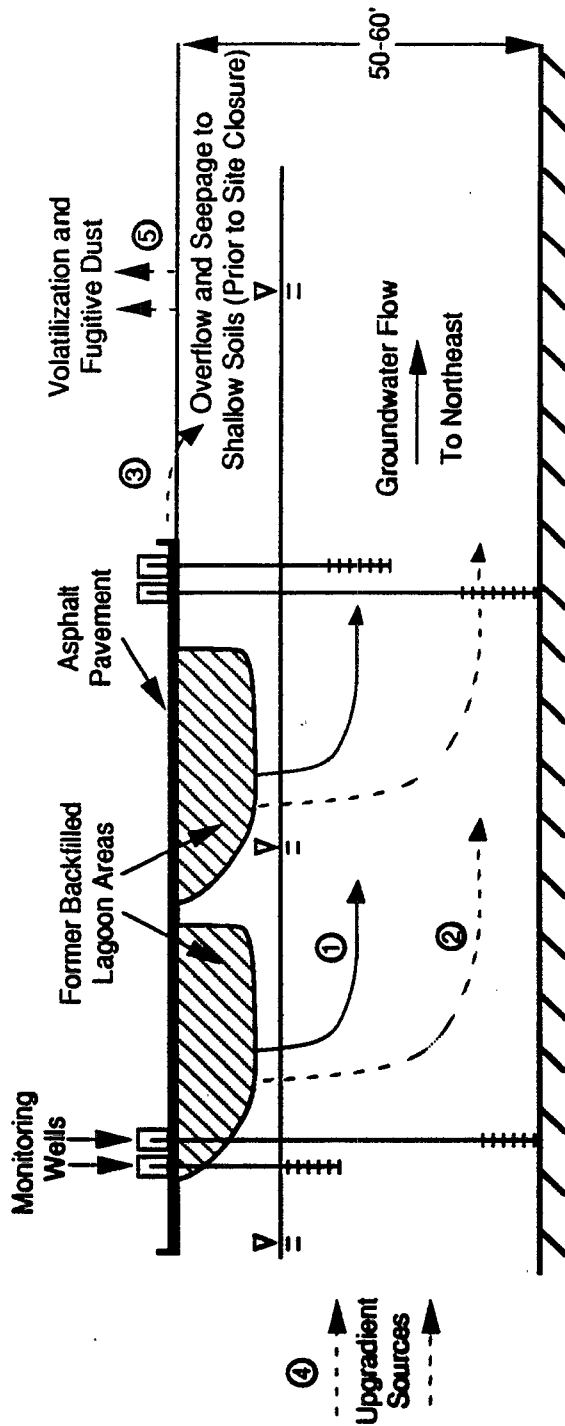


**Figure 2-7**  
**Water Table Contour Map**  
**(17 May 1991)**  
**Tyler Refrigeration Pit Superfund Site**  
**Smyrna, Delaware**



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**Figure 2-8**  
**Potential Migration Pathways**  
**Tyler Refrigeration Pit Superfund Site**  
**Smyrna, Delaware**



**Potential Migration Pathways**

- ① Vertical Leachate Movement to Shallow Groundwater ———> Most Likely Pathways
- ② Vertical Leachate Movement to Deep Groundwater - - - -> Less Likely Pathways
- ③ Overflow of Runoff Affecting Shallow Surficial Soils
- ④ Upgradient Affected Groundwater Migration Toward the Site
- ⑤ Volatilization and Fugitive Dust Emissions

#	Drawn By / Date:	M.S. Smith 2.22.91	Checked By / Date:	M. Schmittle 2.22.91	Notes:
	Revised By / Date:	A. Della Camera 10.31.91	Checked By / Date:	E. Sullivan 10.31.91	
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the Site, and surface drainage from the parking lot area is conveyed via storm drains to a shallow ditch located east of the Site. Based on a review of aerial photographs and a visit to the Site, the ditch has no outlet structure and apparently discharges to ground water via infiltration. Aerial photographs also indicate that the ditch was constructed after the closure of the lagoons.

Based on this conceptual model and the data collected during previous investigations, the potential migration pathways have been identified. These migration pathways are listed below and have been divided into "most likely" and "less likely" categories as shown in Figure 2-8.

Most likely pathway:

- Vertical movement of substances of concern from the former lagoon area into the subsurface and then into the water table, with primarily horizontal migration of dissolved constituents in the shallow ground water flow system.

Less likely pathways:<sup>1</sup>

- Substance migration from the shallow ground water flow system to the deep ground water flow system of the Columbia Formation. Recent water level measurements indicate, however, that there are no vertical hydraulic head gradients within the water table aquifer beneath the Site and therefore little likelihood of migration of substances of concern in the dissolved state to the deep ground water flow system. EPA has also expressed concerns regarding the possible migration of substances of concern to the deep ground water flow system via density effects. If present in sufficient quantities, TCE (at concentrations greater than 1,000 mg/l) and TCA (at concentrations greater than 2,500 mg/l) could form dense non-aqueous phase liquids (DNAPLs), which could migrate (sink) to deeper ground water. However, the 1988

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<sup>1</sup> Each of the potential migration pathways denominated as less likely pathways was judged to be "less likely" relative to vertical movement of substances of concern from the former lagoon area to the shallow ground water system. However, because none of these potential pathways can be wholly eliminated at this juncture based on the data currently available, each will be addressed by specific tasks in this Work Plan.

ground water sampling event did not indicate that substances of concern are present in ground water at high enough concentrations necessary for the formation of DNAPLs. In addition, substances of concern were not detected in any of the deep wells at the Site which are screened at the base of the aquifer. This indicates that substances of concern are quite unlikely to be present in an immiscible state.

- Migration of substances of concern from the lagoon area to adjacent surface soils via overland flow and subsequent volatilization or fugitive dust emission. This migration would have required an overland flow event from the lagoons, which has not been documented. Moreover, the high infiltration rate of the surface soils would have limited any such flow to a very short distance. Without such an overland flow event, there would be no apparent source of substances from the surface soils via volatilization and fugitive emissions.
- Ground water migration to residential or municipal supply wells or surface water bodies. Residential well recipients are not expected due to the apparently complete service of downgradient areas by the Smyrna municipal system. *Based on measurements of ground water elevations to date, ground water flow direction at the Site is apparently not directly toward the Smyrna wells. Ground water flow from the Site is most likely either following an indirect flow path to the Smyrna well or is discharging to Duck Creek, north of Smyrna. Since the creek is approximately 3,000 feet from the Site, no identifiable site-related impacts are expected.*

## 2.6 Preliminary Applicable or Relevant and Appropriate Requirements (ARARs)

Currently, the EPA recognizes drinking water Maximum Contaminant Levels (MCLs), national ambient air quality standards (NAAQSs), and federally approved state water quality standards developed under the Clean Water Act, as applicable or relevant and appropriate requirements (ARARs). The only media likely to transport Site-related substances of concern is ground water. Therefore, a discussion of preliminary ARARs is *primarily* limited to MCLs. Delaware has not established ground water standards. The state has adopted drinking water standards, although these apparently apply only to drinking water supplies. MCLs or Maximum Contaminant Level Goals (MCLGs)

are available for the organic compounds detected in ground water beneath the Site as well as for chromium. The actual concentrations of such compounds in the ground water at the Site are very near or below the federal MCLs for the substances present. *If it is determined during the RI that other environmental media at the Site contain elevated concentrations of substances of concern, then additional ARARs, if in existence for such media, will be identified. If no ARARs exist for a particular media, then health based criteria (using an assumed exposure scenario) may need to be developed to serve as "to be considered" (TBC) guidelines.* Potential ARARs and TBCs are summarized in Table 2-5. The process of refining of ARARs is described in Section 3.3.2 under the development of Remedial Action Objectives in the Feasibility Study. *N<sup>a</sup> /*

## 2.7 Identification of Data Gaps

In order to evaluate the potential for the vertical migration of substances of concern to ground water, subsurface soil sample analyses are necessary. By providing representative sample analyses of unsaturated soils at the Site, this gap can be filled.

No data currently exist regarding background soil or ground water quality. (Based on recent ground water level measurements, existing wells S-3 and D-3, which form the supposed upgradient well nest, are not directly upgradient of the former lagoon area). The installation of an upgradient monitoring well with soils sampling at the same location will provide data to assess the background condition of both soils and ground water and allow evaluation of the potential influence of upgradient source areas.

*An environmental assessment will be conducted at the Site and in the immediate surrounding area. The environmental assessment will include a general ecological characterization of the Site and surrounding area, a baseline potential receptor survey, investigation of potential exposure pathways, and a survey of wetlands and any potential pathways to such wetlands as identified adjacent to the site.*

Data are also necessary regarding the water service areas in the vicinity of the Site. A review of municipal water supply records will provide input on potential downgradient residential receptors.

There are no well nests located further downgradient from the existing well nests to provide water quality and water level data. The installation of two additional downgradient well nest and a subsequent

**Table 2-5**  
**Preliminary ARARs and TBCs**  
**Tyler Refrigeration Pit Superfund Site**  
**Smyrna, Delaware**

Category	ARAR or TBC
Contaminant ARARs	Ground water MCLs
Location specific ARARs	National Historical Preservation Act Endangered Species Act
TBCs	Health Based Criteria, (developed from exposure scenarios for soils or sediments if appropriate)

ARAR= Applicable or Relevant and Appropriate Requirements  
 TBC= To Be Considered  
 MCL= Maximum Contaminant Level

round of ground water sampling and analysis will provide data to fill this gap.

Data will be collected to evaluate the possibility of an overland migration event after the lagoons were removed and backfilled by collecting surface soil samples in the area between the former lagoons and the drainage ditch adjacent to the Site. Because the drainage ditch adjacent to the Site was constructed after the lagoons were removed and backfilled, and the drainage ditch currently receives stormwater runoff from both the Metal Masters parking lot and Glenwood Avenue, it is premature to investigate the drainage ditch until a pathway of overland flow migration from the former lagoons to the ditch is established. Depending on the results of the proposed surface soil sampling, however, sampling within the drainage ditch may be warranted during a subsequent phase of the RI.

Finally, EPA has noted an identified feature in an aerial photograph (July 1954) that is located in the vicinity of the current drainage ditch adjacent to the site. EPA's aerial photograph reviewers have labelled this feature as an "impoundment". The feature will be evaluated by collecting a soil sample at the location of the feature as determined from a geophysical survey and/or aerial photography review.

## **2.8 Data Quality Objectives**

Data Quality Objectives (DQOs) are qualitative and quantitative goals set for data collection to allow the satisfactory completion of the RI/FS process. Section 3 of the QAPP (in the Sampling and Analysis Plan, Appendix A) presents the DQOs for the RI/FS for the Site.

## SECTION 3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)

### 3.1 Work Plan Approach

#### 3.1.1 Phased Investigation

The purpose of the RI at the Site is to characterize the nature and extent of contamination, if any, and the environmental and health risks, if any, posed by conditions at the Site. The results of this investigation will be used to determine if remedial action is necessary, and if so, to evaluate remedial options.

The proposed scope of work for the RI has been designed to maintain a phased and flexible approach to address the investigative needs at the Site. As discussed in Section 3.2.3 of this Work Plan the results of the tasks described in this section of the Work Plan will determine the need for a second round of data collection. The scope of work presented herein has been developed based on pre-existing data generated from past investigations at the Site (see Section 2.3); this data will be incorporated into the RI. The phased approach has been tailored to specifically address each of the potential migration pathways from the Site discussed in Section 2.

The design of this investigation is based on the following considerations:

- The Site is small (approximately 8500 ft<sup>2</sup>).
- The aquifer beneath the Site is under water table conditions with no apparent vertical gradients to the deeper portion of the aquifer.
- *If substances of concern are present at sufficient concentrations to create immiscible phases, those substances could potentially migrate vertically within the aquifer due to density effects, although analytical data to date does not indicate that this has taken place.*
- The ground water flow direction at the Site appears to be to the northeast.
- *The potential exists that Site-related substances of concern in ground water may have impacted Smyrna Well No. 1 by following an indirect flow path from the site into the capture zone of this well.*



- Surface soils at the Site are highly permeable and the topography is nearly flat.

The relative simplicity of the geologic and hydrologic systems at the Site justifies the scope of the investigation presented herein. Should the tasks proposed in this Work Plan show that Site-related substances of concern are migrating off-site at levels which pose an unacceptable risk to human health or the environment and additional tasks are deemed necessary, the Work Plan can be amended to include additional investigative steps. These amendments will take the form of a brief description of the purpose for the additional task(s), the methods to be employed, a schedule for completion of the task(s), and the format for presenting results. *The need for the performance of additional work tasks will be determined as described in Section 3.2.3 of this Work Plan. ERM and Clark will review with EPA data obtained pursuant to this Work Plan and, should a significant amount of additional data collection be warranted, such additional tasks would be performed in a later phase of the RI.*

### 3.1.2 Analytical Design

Based on analytical results from previous investigations at the Site, and confirmed in the Summary Statement of Work for the Site (Exhibit A of the AOC), the substances of concern in soils and ground water at the Site are 1,1,1-trichloroethane, 1,1-dichloroethene and chromium. Accordingly, the analytical suite for a portion of soils and ground water will be comprised of Target Compound List (TCL) VOAs and Target Analyte List (TAL) metals (the Target Substance Suite). To verify that other substances are not present, *the remaining portion* of samples for each matrix will be analyzed for the complete TCL/TAL analytical list including VOAs, SVOAs, pesticides/PCBs, and metals (the Confirmation Suite).

Due to the presence of chlorinated volatile compounds in the ground water, there is a slight possibility of vinyl chloride being present as a degradation product. Vinyl chloride has an MCL of 2 µg/L; normal CLP detection limits are thus too high to rule out the presence of vinyl chloride at or below the MCL.

Therefore, for purposes of the Risk Assessment that EPA will perform, Method 8010 will be used to evaluate selected ground water samples. *This method will provide a lower detection limit (1 µg/L) for vinyl chloride.* Table 3-1 presents the analytical design for the tasks described in this Work Plan.

TABLE 3-1  
ANALYSIS DESIGN SUMMARY  
TYLER REFRIGERATION PIT SUPERFUND SITE

Matrix	Number of Samples	Sampling Points	Analyses	Analytical Method	Container and Preservation	Analysis Holding Time*
Ground Water Confirmation Suite	8	S-1, D-1 S-4, D-4 S-5, D-5 S-6, D-6	TCL Volatiles	CLP	3-40 ml clear glass vials w/ Teflon lined enclosure HCL to pH $\leq$ 2. Cool to 4° C.	14 days
	8	SAME	TCL Semivolatiles	CLP	2-liter amber glass w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation.
	8	SAME	TCL Pesticide/PCBs	CLP	2-liter amber glass w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation.
	8	SAME	TAL Metals	CLP	1-liter plastic HNO3 To pH $\leq$ 2.	180 days; 28 days for mercury.
	8	SAME	TAL Cyanide	CLP	1-liter glass NaOH to pH $\geq$ 12	14 days
Ground Water Target Substance Suite	4	S-2, D-2 S-3, D-3	TCL Volatiles	CLP	3-40 ml clear glass vials w/ Teflon lined enclosure HCL to pH $\leq$ 2. Cool to 4° C.	14 days
	4	S-2, D-2 S-3, D-3	TAL Metals	CLP	1-liter plastic HNO3 To pH $\leq$ 2.	180 days; 28 days for mercury.
Ground Water	4	S-1, S-2 S-5, S-6	Vinyl Chloride	SW-846 Method 8010	3-40 ml clear glass vials w/ Teflon lined enclosure HCL to pH $\leq$ 2. Cool to 4° C.	14 days

\* Holding times are from the date of sample collection.

*Handwritten:* 2/14/90  
2/14/90  
2/14/90

TABLE 3-1 continued  
ANALYSIS DESIGN SUMMARY  
TYLER REFRIGERATION PIT SUPERFUND SITE

Matrix	Number of Samples	Sampling Points	Analyses	Analytical Method	Container and Preservation	Analysis Holding Time*
Soil Borings Confirmation Suite	9 to 14	??	TCL Volatiles	CLP	2-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	9 to 14	??	TCL Semivolatiles	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation.
	9 to 14	??	TCL Pesticide/PCBs	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation.
	9 to 14	??	TAL Metals	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days; 28 days for mercury.
	9 to 14	??	TAL Cyanide	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	14 days

\* Holding times are from the date of sample collection.

? Exact location to be determined.

Note: One sample from the suburface soil boring and one of the surface soil samples will be submitted for Confirmation Suite Analysis.

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TABLE 3-1 continued  
ANALYSIS DESIGN SUMMARY  
TYLER REFRIGERATION PIT SUPERFUND SITE

Matrix	Number of Samples	Sampling Points	Analytes	Analytical Method	Container and Preservation	Analysis Holding Time*
Soil Borings Target Substance Suite	9 to 14	Remaining	TCL Volatiles	CLP	2-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	9 to 14	Remaining	TAL Metals	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days; 28 days for mercury.
Surface Soil Confirmation Suite <i>field plan</i>	4	SS-2, SS-4 SS-6, SS-8	TCL Volatiles	CLP	2-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	4	SS-2, SS-4 SS-6, SS-8	TCL Semivolatiles	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation
	4	SS-2, SS-4 SS-6, SS-8	TCL Pesticides/PCBs	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation
	4	SS-2, SS-4 SS-6, SS-8	TAL Metals	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days; 28 days for mercury.
	4	SS-2, SS-4 SS-6, SS-8	TAL Cyanide	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	14 days

Holding times are from the date of sample collection.

TABLE 3-1 continued  
ANALYSIS DESIGN SUMMARY  
TYLER REFRIGERATION PIT SUPERFUND SITE

Matrix	Number of Samples	Sampling Points	Analyses	Analytical Method	Container and Preservation	Analysis Holding Time*
Surface Soil Target Substance Suite	4	SS-1, SS-3 SS-5, SS-7	TCL Volatiles	CLP	2-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	4	SS-1, SS-3 SS-5, SS-7	TAL Metals	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days; 28 days for mercury.

Quality Assurance Samples	Number of Samples	Sampling Points	Analysis/Analysis Suite
Ground water Trip Blank Rinsete Blank Duplicate MS/MSD	1/day 1 1 1	? ? D-1 S-1	TCL Volatiles only** Full TCL/TAL** Same as sample duplicated** Full TCL/TAL**
Soil Borings Trip Blank Rinsete Blank Duplicate MS/MSD	1/day 1 to 2 1 to 2 1 to 2	? ? ? ?	TCL Volatiles only Full TCL/TAL Same as sample duplicated Full TCL/TAL
Surface Soil Trip Blank Rinsete Blank Duplicate MS/MSD	1/day 1 1 1	? ? ? ?	TCL Volatiles only Full TCL/TAL Same as sample duplicated Full TCL/TAL

Equipment rinsate blanks will be collected at a frequency of 1 per 20 samples, or one per sampling event whichever is more frequent.

Duplicate and MS/MSD samples will be collected at a frequency of 1 per 20 samples

\* Holding times are from the date of sample collection.  
\*\* Will also be analyzed for vinyl chloride by Method 8010

TABLE 3-1 continued  
ANALYSIS DESIGN SUMMARY  
TYLER REFRIGERATION PIT SUPERFUND SITE

Geotechnical  
Samples

Purpose	Number of Samples	Sampling Points	Depth of sample(s)	Analysis
Evaluate Chesapeake group as potential aquitard	2	D-4, D-6	Top of Chesapeake group sediments	Grain size Hydraulic conductivity
Assess fate and transport of residuals	4 to 8	B-4, B-8	One sample from each distinct layer in vadose zone. One sample from saturated zone	Organic matter content Bulk density Hydraulic conductivity

## 3.2 RI Tasks

### 3.2.1 Task 1: Field Investigation

To accomplish the objectives of the RI, the field investigation will include the following tasks:

- Preliminary data collection and review including reports from previous Site investigations and literature on area geology/hydrogeology, a domestic and municipal well inventory, and a review of aerial photographs.
- *An Environmental Assessment*
- Delineation of the location of the former lagoons through a review of aerial photographs *and a geophysical survey* in order to define this location relative to the paved parking lot at the Site.
- A soil investigation program to characterize the extent, if any, of residual soil contamination in and around the former lagoons, to evaluate the potential for migration of substances of concern to ground water, and to assess the potential for volatilization of substances of concern and fugitive dust emissions.
- A hydrogeologic study to verify ground water flow directions and the nature and extent of ground water contamination, if any, at the Site. These data will be used in conjunction with the existing data to confirm downgradient ground water quality, and to provide data necessary to evaluate the risk, if any, posed to the environment and/or public health.

#### 3.2.1.1 Preliminary Data Collection

*The preliminary data collection will include a review of existing literature on area geology and hydrogeology, and a review of reports from previous Site investigations. Information will be obtained on municipal well construction and operation from the Smyrna and Clayton municipal authorities. This information will be used to evaluate the effect of the operation of Smyrna's municipal wells on the ground water flow regime beneath the Site and, if possible, to determine the discharge point(s) of ground water flowing beneath the Site.*

*Possible good explanation of why it is not possible to determine the discharge point if it is not found in the case.*

### Well Inventory

A residential well inventory will be conducted using municipal and state records, as well as water supply service area records. In addition, water supply ordinances will be examined regarding institutional controls on water *development* in the area. This information will be used to evaluate potential downgradient residential receptors.

### Aerial Photograph Review

Aerial photographs will be reviewed to develop a chronology of events at the Site, if possible.

### *Investigation of Past Site Manufacturing Operations*

*Available records will be reviewed to develop, if possible, a summary of past manufacturing operations as they pertain to the former lagoons. However, such records that are currently available are quite limited and consist in large measure of the information gathered on behalf of EPA during past investigations.*

### Site Map

In May of 1991, the six monitoring wells surrounding the Site and the six monitoring wells across Glenwood Avenue from the Site were surveyed for elevation and horizontal position by a Delaware licensed surveyor. This survey data will be plotted onto a Computer Aided Design (CAD) Site map to be provided by Metal Masters. This CAD map will serve as the Site map for the RI/FS.

### 3.2.1.2 Environmental Assessment

*talk to Bob Davis*

### General Ecological and Cultural Characterization

*To accomplish the objectives of characterizing the general ecology of the Site and the surrounding areas, a comprehensive field investigation and literature search will be conducted on the natural resources of the area. ERM ecologists will conduct a field reconnaissance and focus on terrestrial vegetation, general habitats, wildlife, and aquatic life on and near (within one-quarter of a mile) the Site.*

*Terrestrial natural resources and habitats will be characterized by identifying vegetation within the different vegetative communities*





(covertypes) that exist on and adjacent to the Site. Unique characteristics will also be noted. Wetland areas located on and surrounding the Site will also be located and their identity verified. Approximate locations of wetlands, cover types, and unique natural resources observed in the field will be plotted on a topographic map.

Any streams on or adjacent to the Site will be investigated to qualitatively identify the aquatic fauna and macroinvertebrate groups inhabiting the stream. A preliminary assessment of the quality of such streams and the status of the macroinvertebrate community will be made, based upon trophic classifications, diversity, and similarity to non-impacted reference sites for the macroinvertebrate families that are identified in the stream. Sampling of macroinvertebrates will be accomplished by rock picks and kick-net methods.

ERM will also gather available information on terrestrial and aquatic fauna known to inhabit the area around the Site (within one mile) as well as any cultural or historical properties in the vicinity. ERM will contact federal and state game and fish agencies for information on rare, threatened and/or endangered species that occur within one mile of the Site. A list of common species that inhabit each cover type, including sightings or signs of threatened and/or endangered species that have been identified by agencies and other sources will be prepared. The Division of Historical and Cultural Affairs will also be contacted regarding historical properties and Natural Historical Preservation Act requirements.

#### Baseline Potential Receptor Survey and Potential Exposure Pathway Investigation

Visual observations during reconnaissance at the Site and habitat assessment of major cover types will be used as a means to identify potential ecological receptors. Both terrestrial and aquatic species in the Site environs will be identified and recorded. Physical evidence (e.g., scat, small mammal runways, and tracks) will also be used as evidence to verify the presence of species.

The site visit will also be used to gather firsthand information for the development of the exposure analysis. On-site features which may facilitate (e.g., surface runoff conveyances, erosion channels) or mitigate (e.g., surface covers) inter-media transport will also be noted. The location of pertinent exposure points will be identified. Potential pathways to wetland areas will also be identified. If pathways are found to wetland areas, a detailed wetland delineation within any zone of

impact will be conducted at a later time (e.g., a second phase of work) as might be required for the evaluation of remedies proposed in the Feasibility Study. Such a delineation would include the identification and physical flagging of the wetland upland boundaries via the 1987 U.S. Army Corps of Engineers Wetland Delineation Manual.

#### 3.2.1.3 Delineation of Former Lagoon Location

The approximate boundaries of the former lagoons and, if possible, the unidentified feature noted by EPA on the 1954 aerial photograph will be delineated using an Electromagnetic (EM) survey. The EM Survey will be conducted by placing a grid network at each of the former lagoon areas and the 1954 aerial photograph, feature in the locations shown on Figure 3-1. EM Measurements will be taken at each grid node in the network. The locations of the boundaries of the former lagoons as delineated by the EM survey will be staked in the field, surveyed by a Delaware-licensed surveyor and, plotted on the Site CAD map. A more thorough explanation of EM theory and methods can be found in Section 2.1 of the Field Sampling Plan (FSP).

#### 3.2.1.4 Soil Sampling

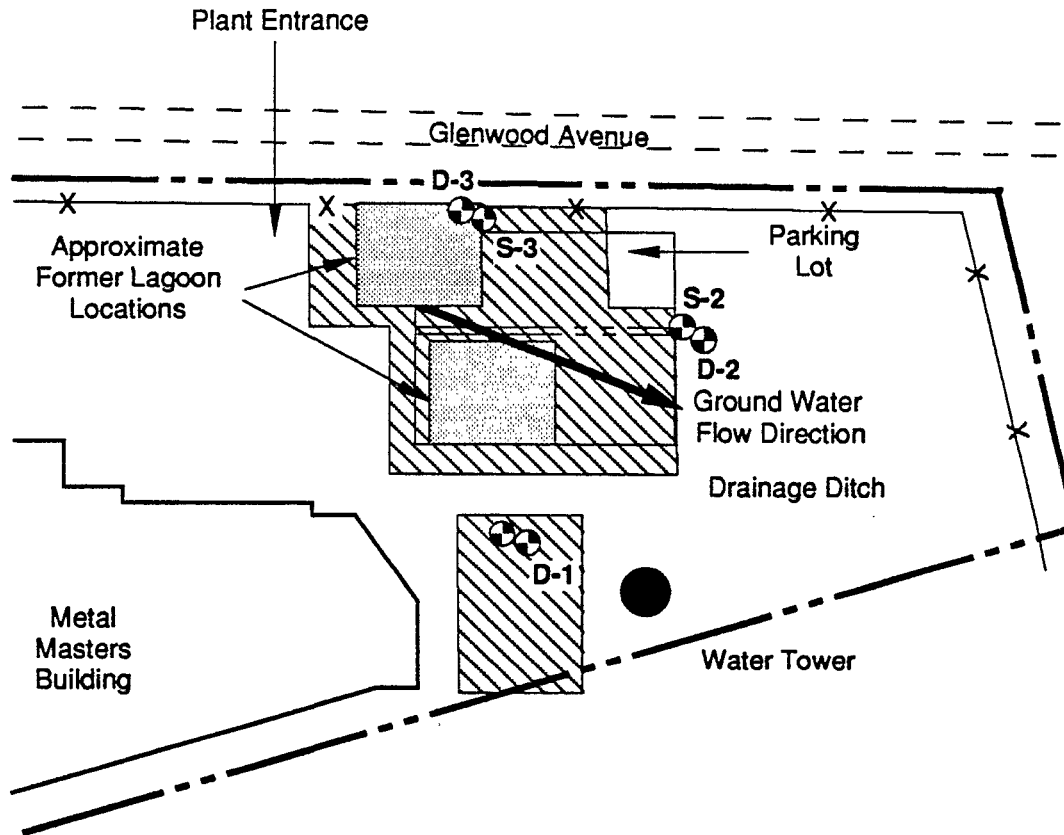
##### Soil Borings and Subsurface Soil Sampling

The purpose of the soil boring program is to:

- characterize the materials within and below the former lagoons;
- identify soil quality in these areas and background soil quality and conditions;
- evaluate the <sup>etc</sup> potential for vertical migration of substances of concern to shallow ground water.
- *determine if the entire area of the former lagoons was excavated.*
- *investigate the areas bordering the former lagoons which may have been impacted by overflow of the lagoons.*

Based on information from aerial photographs, the lagoons were approximately 60 to 70 feet on a side and apparently consisted of a single cell each. Given the small size of the lagoons and their simple design, a dense concentration of sampling locations is unnecessary. In addition, underground utilities may limit the available drilling locations. Therefore, a total of six borings will be sufficient to

# Figure 3-1 Tentative Electromagnetic Survey Area Tyler Refrigeration Pit Superfund Site Smyrna, Delaware



## Legend:

- Existing Monitoring Well
- Electromagnetic Survey Area

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characterize any lateral difference in subsurface soils in the former lagoon area.

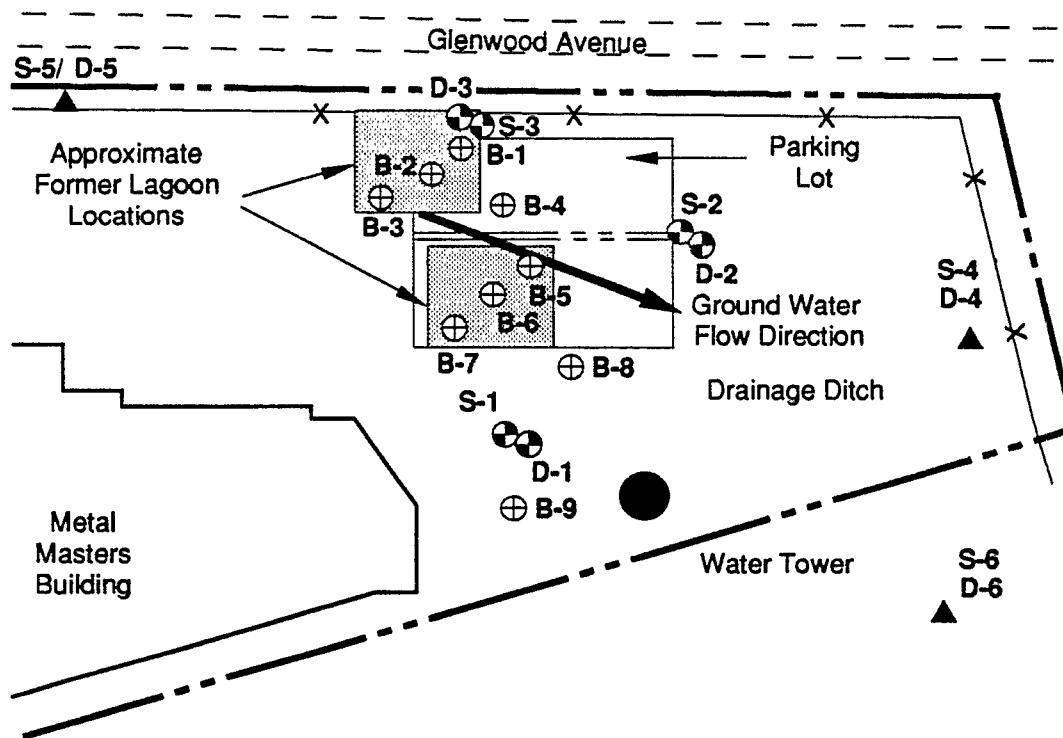
Three soil borings will be drilled in each of the two former lagoons at the approximate locations shown on Figure 3-2. One boring will be drilled at the approximate center of each former lagoon and one will be drilled near the north and south corners to assess lateral differences in depth and soil type. This configuration of soil borings will provide a cross-sectional assessment of each former lagoon area. In addition, one boring will be drilled northeast of each former lagoon to assess the potential impact of overflow from the former lagoons. The borings will be drilled using the hollow stem auger drilling method. Continuous split spoon samples will be collected in advance of the drill bit to the top of the water table. At the present time it is anticipated that up to three distinct materials may be encountered in each boring within the former lagoon boundaries. These materials may include:

- 1) Backfill material from when the lagoons were excavated. It is presumed that clean backfill material was used.
- 2) Residual materials left behind from operation of the lagoons. Such materials may not be present, however, because the lagoons were reportedly excavated to a depth of 20 feet during their removal, placing the bottom of the excavation very near the water table.
- 3) The underlying natural soils between the bottom of the former lagoons and the water table.

One analytical sample will be selected from each distinct material type encountered in each boring within the former lagoons. If only one distinct soil type is identified, two samples will be collected. Thus, a total of two to three analytical samples will be analyzed per boring. Analytical samples will be selected based on a field Organic Vapor Analyzer (OVA) screening as well as visual observations (staining, sludge-like consistency and significant textural changes). Samples generally will be collected from the interval with the highest OVA reading above background from within a material type. In addition, a few select samples will be collected from intervals with low or no OVA readings for comparative purposes, based on the judgement of the field geologist. For soil borings where only one distinct soil type is encountered, two analytical samples will be collected based on OVA screening and visual observations, preferably from varying depths, i.e., one from near the water table and one from near the surface depth.

# Figure 3-2 Tentative Monitoring Well and Soil Boring Locations

Tyler Refrigeration Pit Superfund Site  
Smyrna, Delaware



## Legend:

- Existing Monitoring Well
- Proposed New Monitoring Well Nest
- Proposed Subsurface Soil Sample

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One sample will also be submitted for analysis from the first split spoon interval in each former lagoon where portions of the former lagoon area are unpaved and a boring is advanced in this unpaved area. This sample will be obtained, if possible, from the top 12 inches of the first split spoon, to correspond to surface soil sample depths. The purpose of collecting surface soil samples from unpaved portions of the former lagoon areas is to provide data for the Risk Assessment. => see section 3.2.1.5

For each of the two borings northeast of the former lagoons, one sample will be collected from each distinct soil type encountered up to a maximum of three samples per boring. It is anticipated however, that only one soil type will be encountered in these borings. If one soil type is encountered then two analytical samples will be collected as described above.

One soil boring will also be installed within the area of the unidentified feature noted by EPA in a 1954 aerial photograph. One sample will be selected from this boring for analysis on the basis of OVA screening and visual screening.

In addition to the samples collected in and adjacent to the former lagoon areas, one soil boring will be completed upgradient of the former lagoon areas to provide background data. The background soil boring location will coincide with the new monitoring well location upgradient of the Site (Section 3.2.1.5). Split spoon samples will be collected from the boring during monitoring well installation. Two analytical samples will be selected from this boring using the same protocols used for the soil borings *adjacent to the former lagoon areas* (headspace readings and visual observations). Subsurface soil sampling and decontamination procedures are described in detail in the Field Sampling Plan (FSP) portion of the Sampling and Analysis Plan (SAP)(Appendix A).

Fifty percent of all subsurface soil samples will be analyzed for the Target Substance Suite. The remaining 50% will be analyzed for the Confirmation Suite (including SVOAs, pesticides/PCBs, and cyanide) to confirm the absence of these substances. Samples submitted for each suite will be selected at random. However, at least one sample from each boring will be submitted for Target Substance Suite analysis and at least one will be submitted for Confirmation Suite analysis. The samples will be selected such that samples from a variety of depths and soil types will be submitted for each suite type. Quality assurance procedures for subsurface soil sampling are outlined in the Quality Assurance Project Plan (QAPP) portion of the SAP (Appendix B).

In order to assess the fate and transport of Site-related substances of concern, samples will be collected from the vadose and saturated zones for analyses of organic matter content, bulk density, and hydraulic conductivity. Samples will be collected from Borings B-4 and B-8 outside the former lagoon areas. In each boring one sample will be collected from each distinct soil type in the vadose zone. If only one distinct soil type is encountered, two samples will be collected for organic matter content from varying depths. In order to collect samples from the saturated zone, these borings will be extended several feet below the water table. One sample will be collected below the water table.

#### Soil Gas Survey

A soil gas survey will be conducted in the area outside the former lagoons to identify any "hot spots" which may exist. The information from the soil gas survey will be used in the selection of additional surface soil sampling locations (see subsequent Surface Soil Sampling section). The soil gas survey will be conducted by establishing a grid with a 30-foot spacing over the area shown in Figure 3-3.

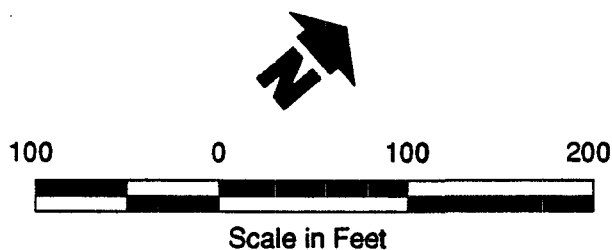
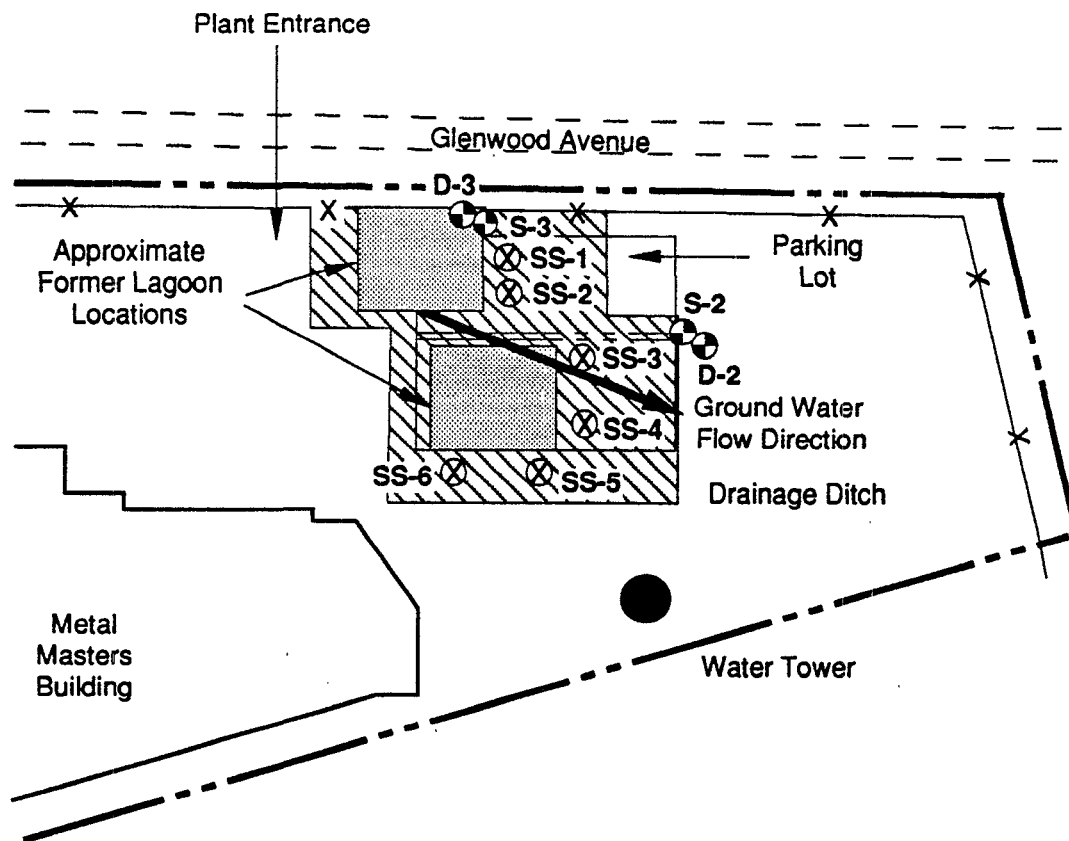
Soil gas sampling will be performed in unpaved areas by completing one-inch borings at each sampling location to an approximate depth of 24 to 36 inches using a gasoline-powered auger. A PVC soil gas probe will then be inserted into the boring (see Figure 2-4 in FSP). A Foxboro Model 128 Organic Vapor Analyzer (OVA) with a flame ionization detector (FID) will be used to draw gas vapors from the soil and measure the total VOC concentration from each boring. Both maximum and stabilized VOC readings will be recorded.

Soil gas samples will be analyzed using a Photovac 10S50 Photoionization Detection (PID) portable gas chromatograph (GC). The GC will be equipped with a capillary column to provide separation of TCE and other chlorinated alkene solvents. This will make it possible to distinguish between soil gas constituents that are potentially Site-related (chlorinated solvents) and non-Site related petroleum hydrocarbons and polynuclear aromatics that may be associated with parking lot runoff and possibly the former oil storage facility across the street.




#### Surface Soil Sampling


The only likely vehicle for causing substances of concern to be present in surface soils is the possibility that the lagoons overflowed prior to

# **Figure 3-3** **Tentative Soil Gas Areas,** **and Surface Soil Sample Locations** **Tyler Refrigeration Pit Superfund Site** **Smyrna, Delaware**



**Legend:**

-  Existing Monitoring Well
-  Soil Gas Survey Area
-  Proposed Surface Soil Sample  
(Two additional samples (SS-7 and SS-8) to be collected from "Hotspots" within Soil Gas Area)

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their removal. No such overflow events have been documented. Moreover, there is a low likelihood of volatile organic compounds remaining in the shallow surface soils at sufficient concentrations to emit to the air or cause concern in connection with fugitive dust emissions. Nevertheless, a sampling program is outlined below to provide data that would allow the Risk Assessment to rule out surface soils as a pathway of concern.

Six surface soil samples will be collected from unpaved areas outside the boundaries of the former lagoons (Figure 3-3). Four surface soil samples are proposed adjacent to the eastern-most former lagoon and two surface soil samples are proposed adjacent to the western-most former lagoon. Two additional surface soil samples will be collected from areas showing the highest soil gas readings, for a total of 8 surface soil samples. The proposed surface soil sample location distribution is based on an assumed scenario in which the eastern-most lagoon is entirely outside the Metal Masters parking lot; and the western-most former lagoon is partially covered by the parking lot. If the results of the EM survey show that the western-most lagoon is entirely covered by the parking lot, then the currently proposed sample distribution will be revised and no samples will be collected adjacent to the western-most former lagoon and six samples will be collected adjacent to the eastern-most former lagoon. These samples would be evenly spaced along the northeast and southeast sides of the former lagoon approximately 10 feet from the former lagoon boundary. In either situation, the total number of surface soil samples adjacent to the former lagoons will be six.

Fifty percent of the surface soil samples will be analyzed for the Target Substance Suite. To confirm the absence of other constituents, the remaining 50% of the surface soil samples collected will be analyzed for the Confirmation Suite. Quality assurance protocols for surface soil sampling are outlined in the QAPP.

Surface soil samples will be collected using a stainless steel hand bucket auger. The auger will be advanced to a depth of approximately 1 foot. Analytical samples will be collected from the 0 to 6-inch and 6 to 12-inch intervals. Samples to be analyzed for volatile organics will be collected from the 6 to 12-inch interval. The 0 to 6-inch sample will be analyzed for the remaining analytical parameters depending on the analytical suite. Samples collected for the Target Substance Suite will be analyzed for inorganics. Samples collected for the Confirmation Suite will be analyzed for inorganics, SVOAs, and

*pesticides and PCBs. Samples for each suite will be selected by submitting every other sample for a particular suite (Samples SS-1, SS-3 and SS-5 and SS-7 for the Target Substance Suite, and Samples SS-2, SS-4, SS-6, and SS-8 for the Confirmation Suite). Surface soil sampling and decontamination procedures are outlined in the FSP.*

### 3.2.1.5 Hydrogeologic Investigation

#### Determination of Ground Water Flow Direction

A minimum of four rounds of ground water level measurements will be collected during the course of the RI. Water level measurements will be collected in the six existing wells surrounding the Site, the six off-site wells across Glenwood Avenue and the additional wells to be installed during the RI. The water level measurements will be used to evaluate changes in ground water flow direction, and to monitor shallow and deep water levels to evaluate the potential for substances of concern to migrate from the shallow to the deep flow zone.

Published information on ground water hydrology in the Smyrna area and the site-specific ground water flow data will be used to evaluate the area of influence of Smyrna Well No. 1 and the potential discharge points of ground water flowing beneath the Site.

#### Water Level Study

A continuous water level study will be performed on monitoring wells S-2, S-6, D-2 and D-6, *and if possible, Smyrna Well No. 1* to evaluate the hydraulic relationship of Smyrna Well No. 1 to the ground water beneath the Site, and to identify potential climatic or ambient background effects such as domestic well pumping on water levels at the Site. This study is intended to confirm the monitoring by Dames and Moore, which indicated that there was no influence on the ground water levels at the Site from the Smyrna municipal wells. Wells S-6 and D-6 have been chosen because they *will be* the closest monitoring wells to Smyrna Well No. 1, and as such, the most likely to be within the area of influence of that well. *The water level study will allow a determination as to whether ground water in the vicinity of the site is within the cone of depression caused by the pumping of Smyrna Well No. 1, which would result in a direct flow path from the vicinity of the site to Smyrna Well No. 1.* Wells S-2 and D-2 have been included as *they are the closest to the position of the former lagoons and this will allow an assessment of whether groundwater beneath the site is within*

*the cone of depression of Smyrna Well No. 1. However, the study may not be conclusive in determining whether the Site is within the catchment area of the Smyrna Well No. 1, which could result in an indirect flow path between the Site and the Smyrna well. A reliable mapping of the catchment area of Smyrna Well No. 1 would likely require an exhaustive study of water levels in this area of Smyrna, which would be impractical and unwarranted.*

During the water level study, Smyrna Well No. 1 will continue to pump on its normal schedule. The water levels in S-2, S-6, D-2 and D-6 will be continuously monitored for a period of 8 days using pressure transducers attached to Hermit® automatic data loggers. The data loggers will be programmed to collect readings on a 10-minute linear time scale. Manual depth-to-water readings will be collected in *all site wells* periodically throughout the study using electronic water level indicators. The manual readings will be compared to the Hermit data to evaluate the accuracy of the Hermit recorded data. Precipitation and barometric pressure data will be collected at the Site using a rain gauge and a barometer.

*The barometer will collect continuous barometric pressure data on a strip chart. The rain gauge will be checked periodically and rain data supplemented by daily data from the nearest weather station. These data will be collected to evaluate potential climatic affects on the water levels at and adjacent to the Site. The Hermit data from Smyrna Well No. 1 will be used to obtain information regarding the pumping schedule and discharge rate of Well No. 1 during the study. If a transducer can not be inserted into this well, then pumping schedule information will be obtained from the town of Smyrna. If a flow meter is located in the pump house then the discharge rate for Well No. 1 will also be recorded. This information will be used to help interpret the data logger results. Water level plots generated from the Hermit data and a catchment area estimate, if possible, will be included in the RI report.*

#### Monitoring Well Installation

Based on the ground water flow directions derived from the preliminary water level measurements, *three* additional monitoring well clusters will be installed at the locations shown on Figure 3-2. One cluster will be installed upgradient from the Site adjacent to Glenwood Avenue and *two* clusters will be installed in the presumed downgradient direction. *One of these clusters (S-4/D-4) will be*

placed downgradient of the former lagoons, and the other cluster S-6/D-6 will be placed downgradient of well cluster S-1/D-1 which had the highest concentrations of 1,1,1-trichloroethane during the 1988 sampling event.

The upgradient well location has been selected to represent background soil and water quality. This well nest will be located approximately 200 feet away from the boundary of the former lagoon area. At this distance, it is not anticipated that any residual mounding effects could remain from the time prior to removal of the lagoons.

The downgradient monitoring well cluster S-4/D-4 will be installed near the northeastern Metal Masters property line. This cluster will be located along the axis of flow from the former lagoon area at the most downgradient location available on the property for well installation. The downgradient monitoring well cluster S-6/D-6 will be installed at a location along the axis of flow from S-1/D-1. This location is also midway between the S-1/D-1 cluster and the S-4/D-4 cluster.

To remain consistent with the existing monitoring wells, each monitoring well cluster will consist of a shallow and a deep monitoring well. The shallow wells will be screened in the upper 10 feet of the water table aquifer and the deep wells will be screened in the lower 10 feet of the water table just above the silt or clay layer which is at the base of the aquifer.

The wells will be drilled using the Hollow Stem Auger drilling method. If running sands become a problem a small diameter (3 1/2-inch) pilot hole will be drilled in advance of the auger using the mud rotary drilling method. This method will allow the collection of split spoon samples for lithologic logging. Once all samples have been collected the hole will be reamed out with the larger diameter hollow stem augers and the well will be installed. This method will provide ease of sampling without the inherent problems of mud rotary well installation. Split spoon samples of the subsurface materials will be collected at 5-foot intervals for the total depth of each well. The samples will be logged in the field by an ERM geologist. To confirm that the Chesapeake Group sediments act as a confining layer at the base of the Columbia aquifer, the borehole for wells D-4 and D-6 will be extended 2-3 feet into Chesapeake sediments. A Shelby tube sample will then be collected and analyzed for grain size analysis and hydraulic conductivity. Before the deep wells are installed, the boreholes will be backfilled with bentonite up to the level of the top of

*the Chesapeake Group sediments. The new wells will be constructed of 4-inch diameter PVC screen (0.02 inch slot) and casing, in accordance with DNREC requirements. A schematic diagram of the proposed monitoring well construction is shown in Figure 3-4. Specific details of well construction are discussed in the FSP.*

Following installation, all new wells will be developed according to the procedures outlined in the FSP and surveyed by a Delaware licensed surveyor. Decontamination protocols for the monitoring well installation program are also outlined in the FSP.

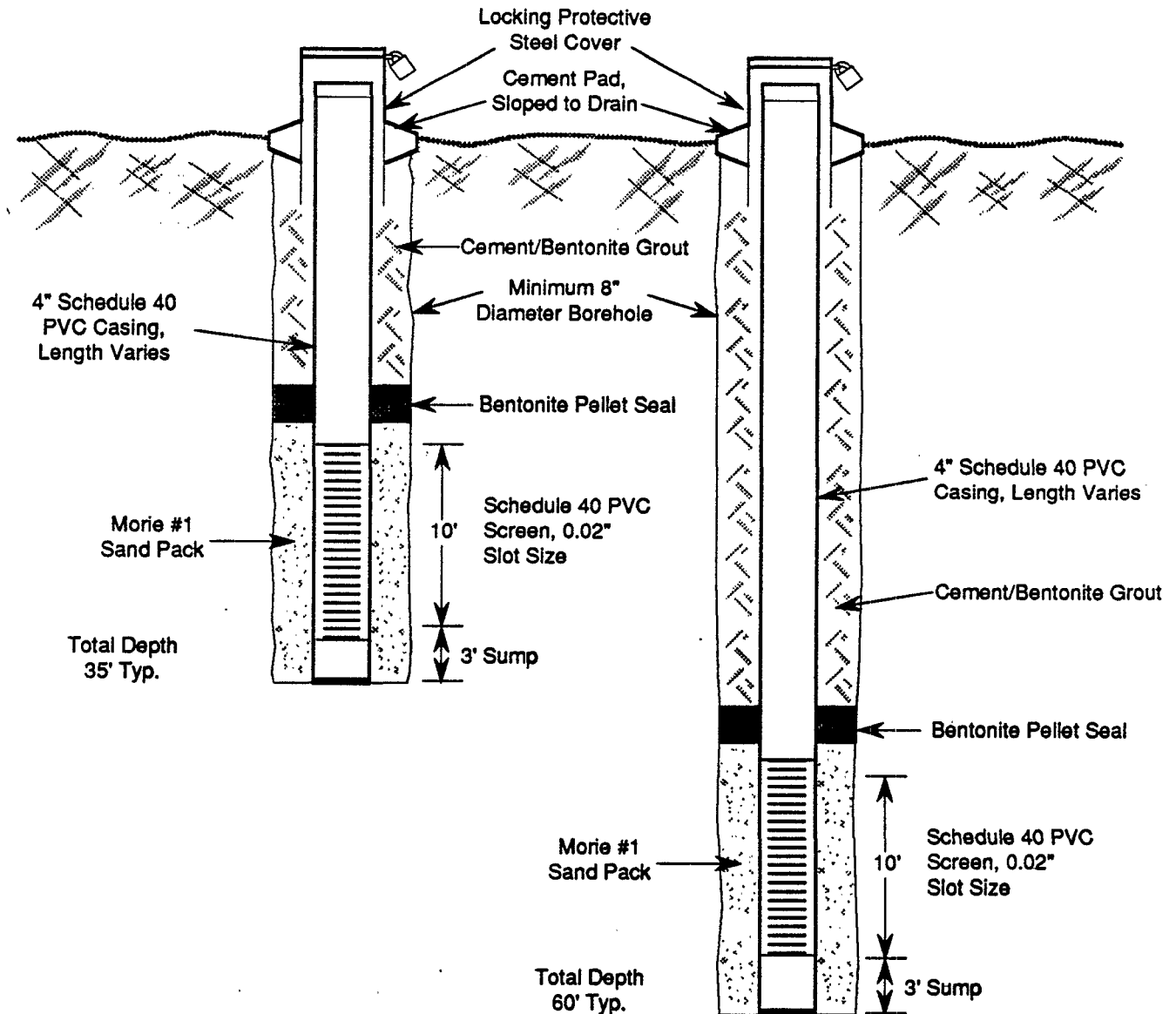
### 3.2.1.6 Ground Water Sampling

At least two weeks after monitoring well installation, ground water samples will be collected from the newly-installed monitoring wells and the six existing monitoring wells. The ground water samples will be collected according to the procedures outlined in the FSP. The samples from wells S-2/D-2 and S-3/D-3 will be analyzed for the Target Substance Suite. The samples from the new wells and wells S-1/D-1 will be analyzed for the Confirmation Suite to confirm the absence of these constituents. All ground water samples for metals analysis will be field filtered. These wells have been selected because the new wells are located in areas that have not previously been sampled and because well S-1 had the highest concentrations of 1,1,1 trichloroethane during the 1988 sampling event.

In addition to the analysis described above, selected ground water samples will be analyzed for vinyl chloride by EPA Method 8010. Wells S-1, S-2, S-5 and S-6 have been selected for this analysis due to their distribution and since shallow wells are more likely to have elevated concentrations of volatile organics. This method provides a lower detection limit (1 µg/L) than the CLP procedure (10 µg/L). By analyzing selected samples by CLP and 8010 methods in tandem, a low concentration gas chromatograph detection of a chlorinated compound can be verified with a mass spectra pattern. This will provide greater confidence that vinyl chloride, a potential degradation product of 1,1,1-trichloroethane and 1,1-dichloroethene, is absent, which may be of importance in connection with the Risk Assessment. Quality Assurance procedures for the ground water sampling are outlined in the QAPP (Appendix A).

*Should it be determined that residential wells currently in use exist in the area, residential well sampling may be conducted, as appropriate, during a later work phase. The selection of residential wells for*

# **Figure 3-4** **Proposed Monitoring Well Construction** Tyler Refrigeration Pit Superfund Site Smyrna, Delaware



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sampling, and the analytical list for analysis, will be based on the ground water flow direction and the ground water analytical results obtained from this investigation.

### 3.2.2 Task 2: On-Site Audit

An on-site system audit will be performed sometime during either the subsurface soil sampling or ground water sampling events to review all field-related quality assurance activities. The system audit will be conducted by *an experienced ERM project geologist not associated with the project*. The acceptance criteria for the field audit will be adherence to the protocols presented throughout the QAPP. Deficiencies found during the audits will be brought to the attention of the responsible individuals and corrective action as per Section 13 of the QAPP will be initiated. Specific elements of the on-site audit are outlined in Section 10 of the QAPP.

### 3.2.3 Task 3: Data Evaluation

Upon completion of the RI field investigation, the resulting data will be compiled, validated, and evaluated. These steps will actually overlap with data collection to a certain extent with data being evaluated as it is received.

Prior to interpretation of the results of sampling, a data validation step will be performed. In this step, ERM's quality assurance chemists will review the Contract Laboratory Program deliverables in accordance with the "Laboratory Data Functional Guidelines for the Evaluation of Organic and Inorganic Analysis" (USEPA) and a Quality Assurance Data Summary Report will be issued concerning the analytical results for each matrix, explaining the reasons behind any data qualifiers.

Upon completion of the analytical data review, all Site analytical data from the RI will be formatted in accordance with the QAPP, and summarized in tables for interpretation. A summary table of all such data will be provided in Lotus 123 format with detection limits shown. Trends in data within each matrix, as well as between matrices will be identified, if present. Any trends will be evaluated in the context of migration pathways and potential exposure routes.

Ground water table contour maps will be developed to define ground water flow directions and evaluate the influence of the Smyrna municipal wells on ground water flow at the Site. Site geologic cross sections will be constructed as appropriate. The analytical results for

the subsurface soils, surface soils, and ground water sampling will be plotted on maps or cross sections of the Site.

If substances of concern not previously detected are found through performance of the RI field investigation or if previously detected substances of concern are found at concentrations substantially above those previously observed, additional work will be proposed as appropriate to close any remaining data gaps. An amendment will be proposed to the Work Plan to provide investigation tasks that will fill these gaps so that a Risk Assessment can be completed.

#### **3.2.4 Task 4: Monthly Reports**

Monthly progress reports will be generated by ERM to describe the technical progress of the investigation. The first monthly report will be submitted to EPA on the 15th day of the month subsequent to the month in which approval of the Work Plan was granted. Until the project is completed, additional monthly reports will be submitted to EPA on the 15th day of the month following the month for which the report is prepared.

Monthly reports will include at a minimum, a summary of work performed to comply with the AOC during the calendar month preceding the report (the reporting period); all results of sampling and tests, analytical data, time-critical interpretations, and other information obtained pursuant to the work under the AOC; problems encountered during the reporting period (e.g., delays in work, problems with analytical data) and the steps taken to overcome the difficulties; and a description of work anticipated to be performed during the next calendar month.

#### **3.2.5 Task 5: Draft RI Report**

Upon completion of Tasks 1, 2 and 3, a draft RI report will be prepared. At a minimum, the draft RI report will include:

- A history of the Site;
- A physical description of the Site;
- A summary of prior investigations and cleanup actions at the Site;
- The technical approach to the investigation;
- Sampling procedures;



- Data generated and interpretations of the data (including maps of sample locations, summary data tables, and copies of the data in a computer-readable format);
- A discussion of data limitations, if any;
- Deliverables generated during the study;
- A Quality Assurance/Quality Control summary of the data;
- A summary of potentially exposed populations;
- A summary of principal conclusions from the study.

The draft RI report will be submitted to EPA for review and approval. A copy of the draft RI report will also be provided to DNREC. Upon receipt of comments from EPA, if any, the draft RI report will be revised as appropriate and resubmitted to EPA for approval.

### **3.2.6 Task 6 - Risk Assessment Coordination**

Upon completion of all data gathering, validation, and interpretation, the results of the RI will be presented to the EPA in a meeting. This meeting will be held at least 30 calendar days prior to the submittal of the RI report to allow EPA to begin to develop its Risk Assessment. A presentation of the findings of the RI will be made and a final format for presentation of the RI data agreed upon. A summary of supporting documentation will be provided along with the RI data.

During the performance of the Risk Assessment, ERM will meet with the EPA to discuss approaches to selecting indicator compounds and assessing exposure pathways and intake rates.

This working review will take place via one or two informal meetings between the EPA toxicologist and RPM and ERM's Risk Assessment Reviewer and PM. Upon receipt of EPA's draft Risk Assessment, ERM will review the Risk Assessment and provide EPA with any comments ERM may have within 30 days.

### **3.3 Feasibility Study**

The Feasibility Study (FS) for the Site will identify and evaluate a range of remedial alternatives to protect human health and the environment from risks, *if any*, associated with the Site. *The FS will also support the subsequent selection of a remedy for the Site if remedial action is found to be necessary.* The FS report will be prepared in compliance with the revised National Contingency Plan (NCP) dated March 1990.

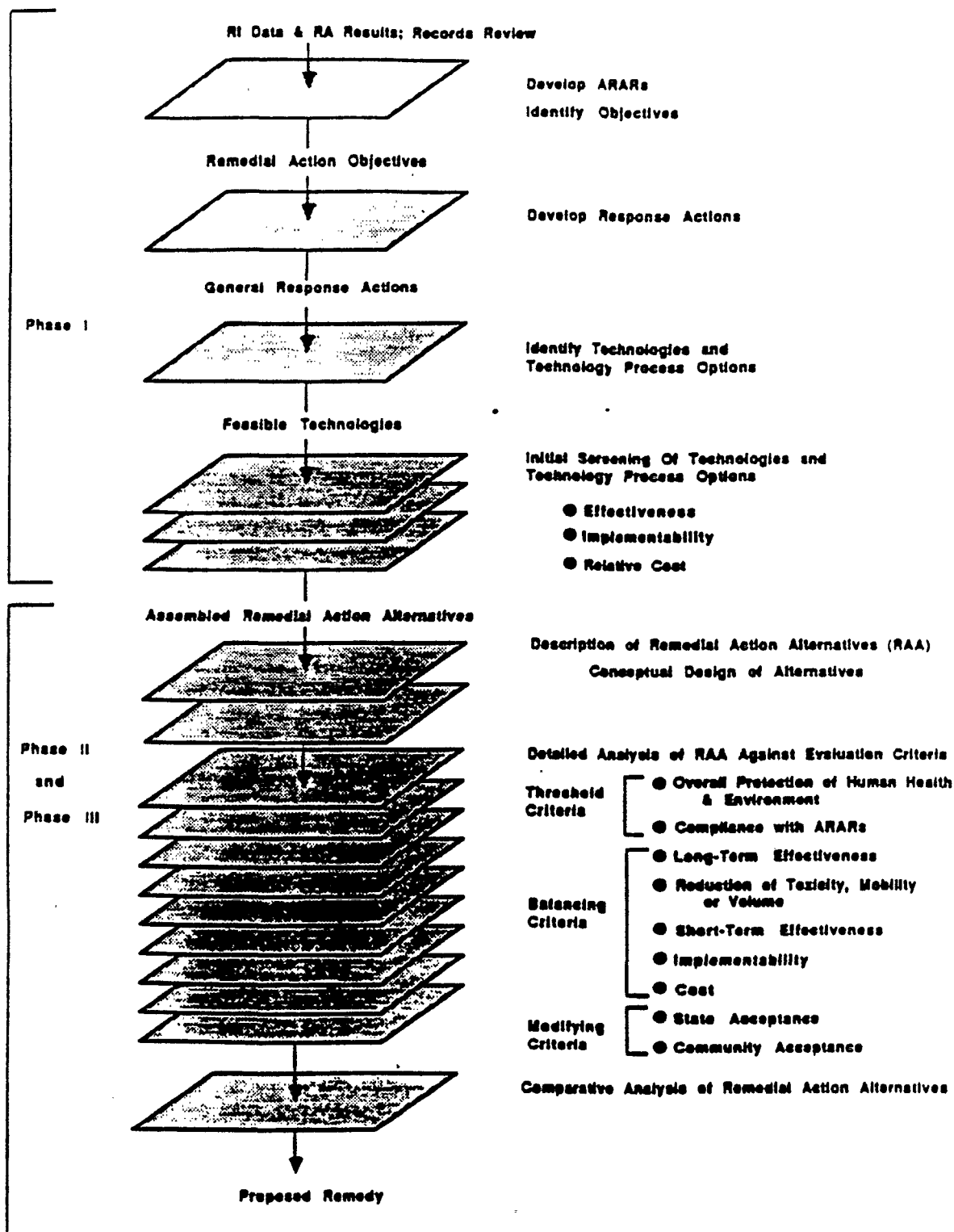
In accordance with EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988), the FS will consist of a multi-phased screening process. Given the characteristics of the Site, ERM proposes that the second and third screening phases of the FS be merged because of the expected limited need to combine technical alternatives for different media into composite remediation alternatives. This modified FS screening process has been approved by EPA Region III in the past for similar sites and is shown in Figure 3-5. Alternatives developed in the FS will be based on the data and interpretations presented in the RI and the RA reports for the Site. *At present, it does not appear that treatability studies will be necessary during the RI/FS. Should such studies be needed, they will be conducted during the remedial design phase.*

### 3.3.1 Report Organization

The FS report will contain three sections:

- Section 1 will provide background information on the Site; summarize the results of the RI and the RA reports; and discuss the previous remedial actions at the facility.
- Section 2 will describe the development of applicable or relevant and appropriate requirements (ARARs) and other criteria for the Site; the designation and description of media requiring remediation; the identification of appropriate remedial action objectives; the development of general response actions for each remedial action objective; the determination of feasible technologies associated with each general response action; the screening of technologies based on effectiveness, implementability, and relative cost; and the assembly of technologies into remedial action alternatives. This section will satisfy the requirements of the Phase I screening process associated with an FS.
- Section 3 will detail and evaluate retained remedial alternatives on the basis of the criteria specified in the 1990 NCP. These criteria are overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost. State and community acceptance will be evaluated after the public comment period on the *proposed remedial action plan (plan)* has closed. This section will satisfy the requirements of the Phase II and III screening process associated with an FS.

# Figure 3-5 Feasibility Study Process Tyler Refrigeration Pit Superfund Site Smyrna, Delaware



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Drawn by / Date: M.S. Smith 7.1.91

Revised by / Date: P. Kryven 11.11.91

Checked by / Date: E. Sullivan 7.1.91

Checked by / Date: E. Sullivan 11.11.91



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### 3.3.2 Overview of Phase I Screening

This section addresses Phase I of the FS process, which will involve the identification and screening of feasible remedial technologies and the subsequent assembly of retained technologies into remedial alternatives for further evaluation. The six steps in Phase I that lead to the development of remedial alternatives are as follows:

**Step 1 - Development of Remedial Action Objectives.** Remedial action objectives will be established during the first step of Phase I. These consist of medium-specific environmental goals to facilitate the development of remedial alternatives that will be protective of human health and the environment. Remedial action objectives specify the substances of concern, potential exposure routes and receptors, and acceptable compound levels or ranges of levels for each potential exposure route, based on potentially applicable or relevant and appropriate requirements (ARARs) and/or risk calculations. To-Be-Considered (TBC) criteria will also be considered, and a detailed discussion of ARARs and TBCs will be provided for the Site. This evaluation, along with a delineation of the media of concern based on the RI and RA, will provide the basis for defining remedial action objectives for the project.

The determination of ARARs for media in the study area is an essential precursor to the proper definition of site-related problems that require remedial action. ARARs will be used to 1) determine the appropriate remedial goals, 2) scope and formulate remedial action alternatives, and 3) govern the implementation and operation of the selected action.

Site-specific ARARs will be identified for each medium of concern in the FS. ARARs may include the following:

- any standard, requirement, criterion, or limitation promulgated under federal environmental law, and
- any promulgated standard, requirement, criterion, or limitation under a state environmental or facility-siting law that is more stringent than the associated federal standard, requirement, criterion, or limitation.

TBC materials are advisories or guidance issued by the federal or state government (e.g., reference doses) that are not generally enforceable and do not have the status of potential ARARs. However, where specific ARARs are not available, guidance documents or advisories will

be considered in determining the necessary level of remediation for protection of human health and the environment.

**Step 2 - Determination of Potentially Appropriate General Response Actions.** Appropriate general response actions will be developed during this step. This will involve the identification of general categories of remedial actions, each of which could provide a remedy or be incorporated into a coordinated remedy for all the media of concern. General response actions will be selected such that either by themselves, or in combination with other general response actions, they will satisfy the remedial action objectives.

**Step 3 - Identification and Characterization of Volumes or Areas of Media to be Evaluated.** This step will take into account the characteristics of the media of concern and requirements for protectiveness in order to identify the volumes and areas to which the general response actions apply.

**Step 4 - Identification and Screening of Technologies.** Based on the general response actions for the media of concern, feasible technology types and technology process options will be identified and screened. Technology types are general categories of technologies (e.g., physical/chemical treatment). Technology process options are defined as specific processes within a technology type (e.g., air stripping). The objective of this screening step will be to eliminate those technologies that are not technically appropriate for the media of concern.

**Step 5 - Evaluation of Technology Process Options.** In this step, the feasible technology types and technology process options that passed the initial screening will be further evaluated in a comparative screening of effectiveness, implementability, and relative cost.

**Step 6 - Assembly of Remedial Alternatives.** Feasible process options retained during the screening process will be selected and assembled into proposed remedial alternatives for the Site.

### **3.3.3 Overview of Detailed Screening**

In the detailed evaluation, each alternative will be assessed against the specific requirements contained in the Superfund Amendments and Reauthorization Act of 1986 (SARA):

Nine criteria for detailed screening of remedial alternatives were included by EPA in its FS Guidance Document (October 1988). These criteria are:

- overall protection of human health and the environment;
- compliance with ARARs;
- long-term effectiveness and permanence;
- reduction of toxicity, mobility, or volume;
- short-term effectiveness;
- implementability;
- cost;
- state acceptance; and
- community acceptance.

These nine criteria will be examined in three groups in accordance with the National Contingency Plan (NCP):

- Threshold criteria must be satisfied before a remedy is considered. These criteria are:
  - overall protection of human health and the environment; and
  - compliance with ARARs.
- Primary balancing criteria are used to weigh trade-offs among alternatives. These consist of, in the order of importance assigned by EPA:
  - long-term effectiveness and permanence;
  - reduction of toxicity, mobility, or volume;
  - short-term effectiveness;
  - implementability; and
  - cost.
- Modifying criteria may modify a proposed remedy based on:
  - state acceptance; and
  - community acceptance.

A description of how each criterion will be addressed in the FS is presented in the following paragraphs.

### 3.3.3.1 Overall Protection of Human Health and the Environment

This criterion will provide a final check to assess whether the alternatives are protective of human health and the environment. The overall assessment of protectiveness is based on a composite of factors assessed under the evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. Each alternative will be analyzed to determine how it achieves protection over time, how risks are reduced for the pathways being addressed, and how the source of concern is to be eliminated, reduced, or controlled.

### 3.3.3.2 Compliance with ARARs

Each alternative will be evaluated to determine how it complies with federal and state ARARs. If an ARAR cannot be met, the *basis for obtaining* a waiver as allowed under SARA will be discussed.

### 3.3.3.3 Long-Term Effectiveness and Permanence

Evaluation of this criterion will determine the long-term effectiveness of alternatives for protecting human health and the environment after remedial objectives have been met. The primary focus of this evaluation will be the extent and effectiveness of the controls that may be required to manage the potential risks posed by treatment residuals and/or untreated substances of concern. The following components will be addressed under this criterion:

- magnitude of remaining risk - assesses the residual risk remaining from untreated media at the conclusion of remedial activities;
- adequacy of controls - considers the adequacy and suitability of controls, if any, that are used to manage treatment residuals at the Site; determines whether these controls are sufficient to ensure that any possible exposure to human and environmental receptors is within protective limits;
- reliability of controls - evaluates the long-term reliability of management controls for providing continued protection from residuals; and
- the degree of permanence of the remedial measures undertaken, including the need for five-year effectiveness reviews. These reviews would examine remedy performance to date and evaluate the need for further remedial action.

#### 3.3.3.4 Reduction of Toxicity, Mobility, or Volume

This evaluation criterion will address the statutory preference for selecting remedial actions that employ treatment technologies to permanently and significantly reduce toxicity, mobility, or volume of wastes. This criterion will focus on the following factors:

- the amount of hazardous materials that will be destroyed or treated, including how principal threats will be addressed;
- the degree to which hazardous materials will be destroyed or treated, including how principal threats will be addressed;
- irreversibility of treatment; and
- the type and quantity of residuals that will remain following treatment.

#### 3.3.3.5 Short-Term Effectiveness

This criterion will examine the effectiveness of alternatives for protecting human health and the environment during the construction and implementation period until the remedial objectives have been met. The following factors will be addressed under this criterion:

- protection of the community during remedial actions - addresses the potential risks to human health from implementation of the proposed remedial action (e.g., fugitive dust emissions from site work);
- protection of on-site workers during remedial actions - assesses potential risks to on-site workers as well as the effectiveness and reliability of protective measures to reduce worker exposure;
- environmental impacts - addresses the potential adverse environmental impacts that may result from implementation of an alternative and evaluates the effectiveness of available mitigative measures to prevent or reduce impacts; and
- time until remedial response objectives are achieved - estimates the time required to achieve protection for either the entire Site or for individual elements associated with specific threats.

#### 3.3.3.6 Implementability

The implementability criterion will address the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during



implementation. This criterion will involve analysis of the following factors:

#### Technical Feasibility

This aspect of implementability will examine the following:

- feasibility of remedy construction and operation, relating to the technical difficulties and unknowns associated with component technologies;
- reliability of technologies, focusing on the ability of technologies to meet specified process efficiencies or performance goals;
- ease of undertaking additional remedial action, including the types, if any, of future remedial actions that may be undertaken and the difficulty of implementing such additional actions; and
- monitoring considerations which address the ability to monitor the effectiveness of a remedy.

#### Administrative Feasibility

This subcriterion addresses activities requiring coordination with other regulatory offices and agencies (e.g., obtaining permits, deed restrictions, restrictions on ground water use).

#### Availability of Services and Materials

This subcriterion examines the following:

- availability of adequate off-site treatment, storage capacity, and disposal services for treatment system residuals;
- availability of necessary equipment, specialists, and the provisions for obtaining any necessary additional resources;
- timing of the availability of technologies under consideration; and
- availability of services and materials, plus the potential for obtaining competitive bids.

#### 3.3.3.7 Cost

Cost evaluation of each alternative will include consideration of capital costs and annual costs. The accuracy provided by these cost estimates will range from plus 50 percent to minus 30 percent. A present worth analysis will also be conducted, allowing all remedial action

alternatives to be compared on the basis of a single cost. These three components are discussed in the following paragraphs:

- capital costs - capital costs consist of direct (i.e., construction) and indirect (i.e., nonconstruction and overhead) costs. Direct costs include expenditures for the equipment, labor, and materials necessary to install remedial actions. Indirect costs include expenditures for engineering, treatability studies, financial, and other services that are not part of the actual installation activities but are required to complete the installation of a remedial alternative.
- annual costs - annual costs are post-construction costs necessary to ensure the continued effectiveness of a remedial action, including utilities, chemicals, residuals disposal, and labor.
- present worth analysis - after completion of the cost estimate, an economic analysis considering the time value of money will be conducted to allow comparison of alternatives. The comparison will be made through a present worth analysis. Expenditures that occur over different time periods will be evaluated by discounting future costs to the current year. This single figure represents the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life. A 5 percent discount rate over 30 years will be used for present worth analysis.

#### 3.3.3.8 State Acceptance

This criterion evaluates the technical and administrative issues and concerns that DNREC may have regarding each of the alternatives. Because DNREC will not have been provided with a formal opportunity to review the detailed analysis of remedial alternatives at the time the draft FS report is written, no formal comments from DNREC will be available *initially* for evaluation of this criterion. *However, comments from DNREC, if any, on the draft FS will be incorporated as appropriate in the final FS submittal.*

#### 3.3.3.9 Community Acceptance

This criterion incorporates public comments into the evaluation of the remedial alternatives. Because the public will not have been provided with a formal opportunity to review the detailed analysis of remedial alternatives before the FS report is written, no formal comments from the public will be available for evaluation of this criterion.

#### **3.3.4 Comparative Analysis Among Alternatives**

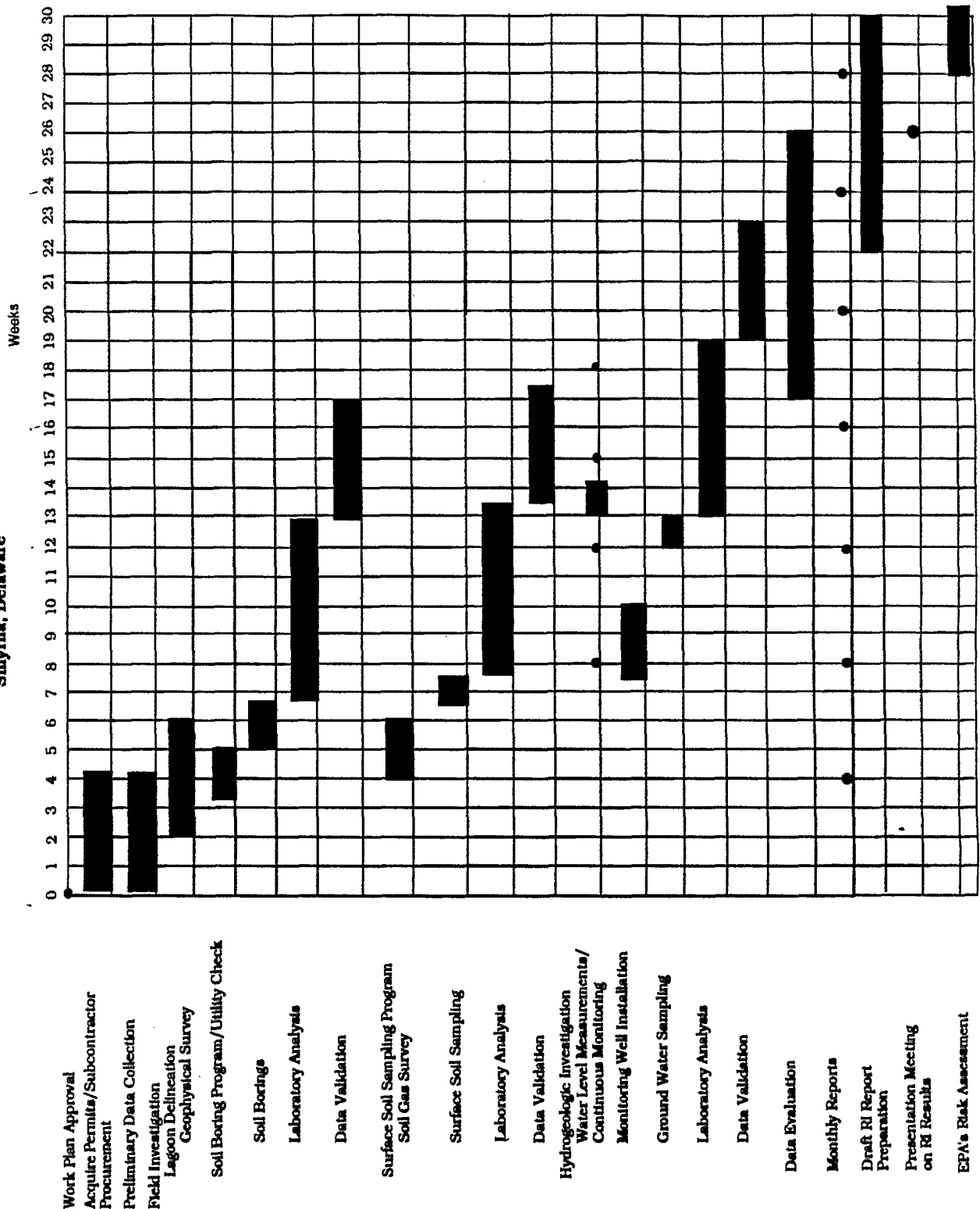
After each alternative has been individually evaluated against the nine criteria set forth above, comparisons among the alternatives will be made. The range of alternatives will be compared criterion by criterion, emphasizing the important tradeoffs among alternatives. This comparison will permit recommendation of the most appropriate remedial action for the Site.

## **SECTION 4 PROJECT SCHEDULE**

The tentative schedule for the RI/FS is presented in Figure 4-1. This tentative schedule illustrates the anticipated time frames for individual tasks and deliverables.

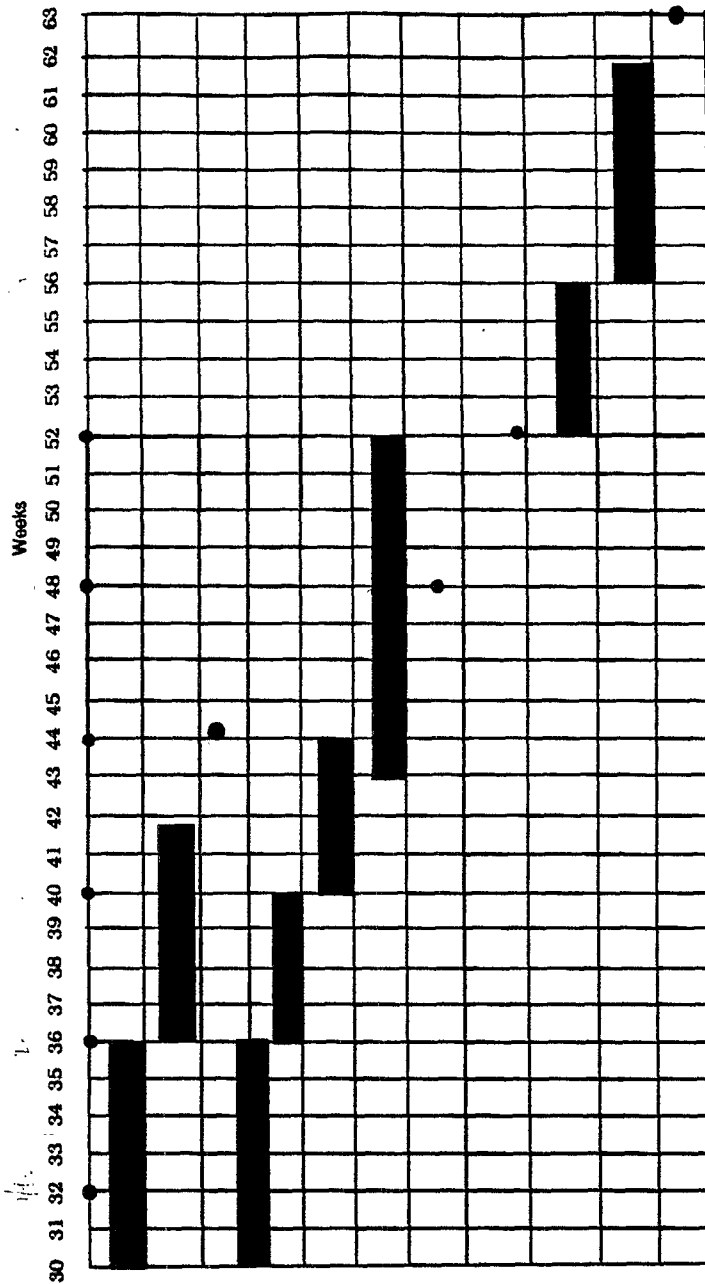
The schedule assumes that no delays are caused by circumstances beyond Clark's or ERM's control such as turn-around-time for regulatory review, extreme weather conditions, problems associated with access or utilities. Individual field efforts shown on the attached figure may be rearranged/reordered to continue work if delays impact other efforts. Moreover, the time from for completing any action that is dependant upon previous actions will not be triggered until completion of the previous actions. Should revisions to the schedule be necessary this will be reported to the EPA and a revised schedule will be submitted as an amendment to the Work Plan

Figure 4-1  
Tyler Refrigeration RI/FS Project Schedule  
Former Tyler Refrigeration Site  
Smyrna, Delaware



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Figure 4-1, continued  
Tyler Refrigeration RI/FS Project Schedule  
Former Tyler Refrigeration Site  
Smyrna, Delaware



Note: Schedule Assumes Duration of EPA Activities; Differences in EPA Turnaround Will Affect Schedule Accordingly.

See Section 4 for Schedule Limitations

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begin sooner  
at least 10 weeks  
at least 10 weeks  
at least 10 weeks

1. The first step is to...  
2. The second step is to...  
3. The third step is to...  
4. The fourth step is to...  
5. The fifth step is to...

## **SECTION 5 PROJECT MANAGEMENT**

### **5.1 Project Staffing**

The following ERM personnel have been designated to serve as the RI/FS management team (Figure 5-1).

#### **5.1.1 Principal-in-Charge**

Mr. Al Funk is the principal-in-Charge for the RI/FS. Mr. Funk has 17 years experience conducting geologic, hydrogeologic and geotechnical investigations at sites involving hazardous, radioactive, industrial or sanitary wastes. This investigation experience includes serving as the Project Manager or Project Director on eight Superfund projects and five RCRA or other non-Superfund projects in Region III.

Mr. Funk will have the following functions: (1) maintain the overall technical quality of the project, (2) ensure proper allocation of company resources to the project, (3) ensure proper technical integration during the project, and (4) provide an alternate channel, in addition to the Project Manager, for client communication. Mr. Funk is a Registered Professional Geologist in Delaware (No. 334) and will seal all technical reports, as appropriate.

#### **5.1.2 Project Manager**

Mr. David Steele is the Project Manager for the RI/FS. Mr. Steele has over eight years of experience in environmental consulting. His experience as a project manager includes several RI/FS investigations under CERCLA and the New York State Superfund programs. Mr. Steele has worked on six Superfund projects in EPA Regions II/III:

Mr. Steele will serve the following functions: (1) overall responsibility for ensuring that project goals, budgets, and deadlines are met, (2) responsibility for maintaining technical quality control, (3) responsible for interfacing with the parties to communicate the progress of each task and ensuring coordination and uniform technical quality among the RI team, the Risk Assessment Review team, and the FS team, (4) meet regularly with all key project personnel, and EPA to discuss project status, correct potential difficulties, and anticipate potential problems so that timely solutions can be applied.

As the Project Manager, Mr. Steele will be responsible for the project budgets and schedules, data management, and the production of all documents.

#### *5.1.3 Quality Assurance Manager*

Ms. Shawne Rogers is the Quality Assurance manager for the RI/FS. Ms. Rodgers has over five years of experience in the field of environmental consulting, a large portion of which is related to quality assurance programs. She is experienced in the preparation and review of quality assurance project plans (QAPPs) and analytical plans. Ms. Rodgers has extensive knowledge of U.S. EPA analytical methodologies including those outlined in the U.S. EPA Contract Laboratory Program (CLP) Statement of Work (SOW), and has performed validation of organic and inorganic analytical data generated from samples collected at numerous Superfund Sites.

As the Senior Quality Assurance Chemist for the project, Ms. Rodgers' responsibilities will include assistance in planning the types of analyses and analytical protocols to be used on the project, supervision of the writing of the QAPP, supervision of the field and laboratory audits, and supervision of the data validation process for all analytical data collected from the Site.

#### *5.1.4 Feasibility Study Manager*

Ms. Ruth Baker is the Feasibility Study Manager for the RI/FS. Ruth Baker is a licensed professional engineer in Pennsylvania with five years experience in environmental engineering. The majority of her work during this period has involved feasibility study development and remedial measure design for Superfund Sites. She has managed and served as principal author on FS reports and related studies for a number of facilities. Ms Baker has overall responsibility for the day-to-day FS activities.

#### *5.1.5 Risk Assessment Review Coordinator*

Ms. Robin Streeter is the Risk Assessment Review Coordinator for the RI/FS. Ms. Streeter has over twelve years of professional experience in the environmental sciences and engineering, with considerable involvement in project and task management. Over the past three years, she has been solely involved in performing and managing risk assessments (RAs). She has conducted numerous RAs for both CERCLA and non-CERCLA Sites; these projects have entailed



evaluating multiple exposure pathways for the various populations identified as potentially at risk.

#### *5.1.6 Field Operations Manager/Project Geologist*

Mr. Edward Sullivan will serve as the Field Operations Manager/Project Geologist for this investigation. Mr. Sullivan has over 5 years experience in environmental consulting including extensive soil and ground water sampling and monitoring well installation experience. As field operations Manager/Project Geologist, Mr. Sullivan will be responsible for all soil boring and well installation field tasks and the day to day activities of all ERM field personnel. The Field Operations Manager/Project Geologist is responsible for all field quality assurance. Further responsibilities include the verification for accuracy of all field notebooks, drillers logs, chain-of-custody records, sample labels, and all other field related documentation.

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## **APPENDIX A**

### **RI/FS SAMPLING AND ANALYSIS PLAN TYLER REFRIGERATION PIT SUPERFUND SITE SMYRNA, DELAWARE**

#### **Components:**

**Field Sampling Plan - 12 November 1991**

**Quality Assurance Project Plan - 12 November 1991**

**Prepared For:**  
**Clark Equipment Company**  
100 N. Michigan Street  
South Bend, IN 46634

**Prepared By:**  
**Environmental Resources Management, Inc.**  
855 Springdale Drive  
Exton, Pennsylvania 19341

**File No.: C27-01-01**



**AR300433**

**FIELD SAMPLING PLAN  
TYLER REFRIGERATION PIT  
SUPERFUND SITE  
RI/FS WORK PLAN**

12 November 1991

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Alan Funk, P.G.  
Project Director

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David Steele  
Project Manager

---

Edward Sullivan, P.G.  
Project Geologist

Prepared For:  
**Clark Equipment Company**  
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File No.: C27-01-01



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# FIELD SAMPLING PLAN

## 1.0 Introduction

### 1.1 Purpose and Content

The purpose of this Field Sampling Plan (FSP) is to detail the sampling and data gathering methods to be used during the Remedial Investigation (RI) of the Tyler Refrigeration Pit Superfund Site (the Site). The following sections describe the equipment to be employed, the quality assurance measures to be taken in the field and protocols for sample handling and submission.

### 1.2 Scope of Work

The field sampling effort will include subsurface and surface soil sampling programs to define the extent of soil contamination within, below and adjacent to the lagoons; and a hydrogeologic investigation which will include the installation and sampling of additional monitoring wells at the Site. Table 1-1 presents a summary of the samples to be collected in each matrices and the analyses to be performed.

## 2.0 Description of Field Sampling Methods

### 2.1 Geophysical Investigation

#### 2.1.1 Objectives and Scope

The purpose of the geophysical survey is to assist in delineating the boundaries of the former lagoons at the Site. (Aerial photographs will also be used to help delineate the former lagoons.) In addition, the geophysical survey will assist in investigating the unidentified feature labelled by EPA as an impoundment on a 1954 aerial photograph. To achieve these objectives, electromagnetic conductivity (EM) methods will be utilized to indicate lateral variations in characteristics of soil materials near the surface of the ground (i.e., on the order of 10 to 20 foot depth of penetration). This method measures changes in subsurface conductivity and requires that an electrical contrast is present between the target and surrounding media so that the object or layer is detectable in the field. Generally, backfill soils exhibit higher porosities and water content than adjacent, undisturbed soils. The increases in

TABLE 1-1  
ANALYSIS DESIGN SUMMARY  
TYLER REFRIGERATION PIT SUPERFUND SITE

Matrix	Number of Samples	Sampling Points	Analyses	Analytical Method	Container and Preservation	Analysis Holding Time*
Ground Water Confirmation Suite	8	S-1, D-1 S-4, D-4 S-5, D-5 S-6, D-6	TCL Volatiles	CLP	3-40 ml clear glass vials w/ Teflon lined enclosure HCL to pH $\leq$ 2. Cool to 4° C.	14 days
	8	SAME	TCL Semivolatiles	CLP	2-liter amber glass w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation.
	8	SAME	TCL Pesticide/PCBs	CLP	2-liter amber glass w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation.
	8	SAME	TAL Metals	CLP	1-liter plastic HNO <sub>3</sub> To pH $\leq$ 2.	180 days; 28 days for mercury.
	8	SAME	TAL Cyanide	CLP	1-liter glass NaOH to pH $\geq$ 12	14 days
Ground Water Target Substance Suite	4	S-2, D-2 S-3, D-3	TCL Volatiles	CLP	3-40 ml clear glass vials w/ Teflon lined enclosure HCL to pH $\leq$ 2. Cool to 4° C.	14 days
	4	S-2, D-2 S-3, D-3	TAL Metals	CLP	1-liter plastic HNO <sub>3</sub> To pH $\leq$ 2.	180 days; 28 days for mercury.
Ground Water	4	S-1, S-2 S-5, S-6	Vinyl Chloride	SW-846 Method 8010	3-40 ml clear glass vials w/ Teflon lined enclosure HCL to pH $\leq$ 2. Cool to 4° C.	14 days

\* Holding times are from the date of sample collection.

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TABLE 1-1 continued  
ANALYSIS DESIGN SUMMARY  
TYLER REFRIGERATION PIT SUPERFUND SITE

Matrix	Number of Samples	Sampling Points	Analyses	Analytical Method	Container and Preservation	Analysis Holding Time*
Soil Borings Confirmation Suite	9 to 14	??	TCL Volatiles	CLP	2-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	9 to 14	??	TCL Semivolatiles	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation.
	9 to 14	??	TCL Pesticide/PCBs	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation.
	9 to 14	??	TAL Metals	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days; 28 days for mercury.
	9 to 14	??	TAL Cyanide	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	14 days

\* Holding times are from the date of sample collection.

? Exact location to be determined.

Note: One sample from the subsurface soil boring and one of the surface soil samples will be submitted for Confirmation Suite Analysis.

TABLE 1-1 continued  
ANALYSIS DESIGN SUMMARY  
TYLER REFRIGERATION PIT SUPERFUND SITE

Matrix	Number of Samples	Sampling Points	Analytes	Analytical Method	Container and Preservation	Analysis Holding Time*
Soil Borings Target Substance Suite	9 to 14	Remaining	TCL Volatiles	CLP	2-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	9 to 14	Remaining	TAL Metals	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days; 28 days for mercury.
Surface Soil Confirmation Suite	4	SS-2, SS-4 SS-6, SS-8	TCL Volatiles	CLP	2-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	4	SS-2, SS-4 SS-6, SS-8	TCL Semivolatiles	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation
	4	SS-2, SS-4 SS-6, SS-8	TCL Pesticides/PCBs	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days til extraction; analysis w/i 40 days of extract preparation
	4	SS-2, SS-4 SS-6, SS-8	TAL Metals	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days; 28 days for mercury.
	4	SS-2, SS-4 SS-6, SS-8	TAL Cyanide	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	14 days

\* Holding times are from the date of sample collection.



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TABLE 1-1 continued  
ANALYSIS DESIGN SUMMARY  
TYLER REFRIGERATION PIT SUPERFUND SITE

Matrix	Number of Samples	Sampling Points	Analyses	Analytical Method	Container and Preservation	Analysis Holding Time*
Surface Soil Target Substance Suite	4	SS-1, SS-3 SS-5, SS-7	TCL Volatiles	CLP	2-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	4	SS-1, SS-3 SS-5, SS-7	TAL Metals	CLP	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days; 28 days for mercury.

Quality Assurance Samples	Number of Samples	Sampling Points	Analysis/Analysis Suite
Ground water			
Trip Blank	1/day	?	TCL Volatiles only**
Rinse Blank	1	?	Full TCL/TAL**
Duplicate	1	D-1	Same as sample duplicated**
MS/MSD	1	S-1	Full TCL/TAL**
Soil Borings			
Trip Blank	1/day	?	TCL Volatiles only
Rinse Blank	1 to 2	?	Full TCL/TAL
Duplicate	1 to 2	?	Same as sample duplicated
MS/MSD	1 to 2	?	Full TCL/TAL
Surface Soil			
Trip Blank	1/day	?	TCL Volatiles only
Rinse Blank	1	?	Full TCL/TAL
Duplicate	1	?	Same as sample duplicated
MS/MSD	1	?	Full TCL/TAL

Equipment rinseate blanks will be collected at a frequency of 1 per 20 samples, or one per sampling event whichever is more frequent.

Duplicate and MS/MSD samples will be collected at a frequency of 1 per 20 samples

\* Holding times are from the date of sample collection.  
\*\* Will also be analyzed for vinyl chloride by Method 8010

TABLE 1-1 continued  
ANALYSIS DESIGN SUMMARY  
TYLER REFRIGERATION PIT SUPERFUND SITE

Geotechnical Samples				
Purpose	Number of Samples	Sampling Points	Depth of sample(s)	Analysis
Evaluate Chesapeake group as potential aquitard	2	D-4, D-6	Top of Chesapeake group sediments	Grain size Hydraulic conductivity
Assess fate and transport of residuals	4 to 8	B-4, B-8	One sample from each distinct layer in vadose zone. One sample from saturated zone	Organic matter content Bulk density Hydraulic conductivity

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soil moisture result in equivalent increases in terrain or soil conductivity measured by the EM instrument.

### *2.1.2 Field Techniques*

A series of 54 EM survey lines comprising 243 station points will be established to provide coverage over the areas of investigation. A 200 foot by 200 foot grid network will be established at each of the two former lagoon areas and in the area of the unidentified aerial photograph feature (Figure 2-1). This coverage will maximize the probability that successful boundary delineation will be accomplished. All field station measurements will be made with a Brunton Pocket Transit and cloth measuring tape, and anomalies will be identified in the field with labeled pin flags.

### *2.1.3 Methods and Theory*

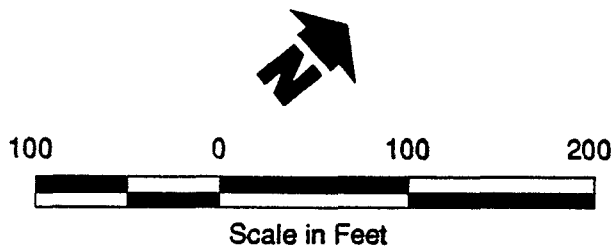
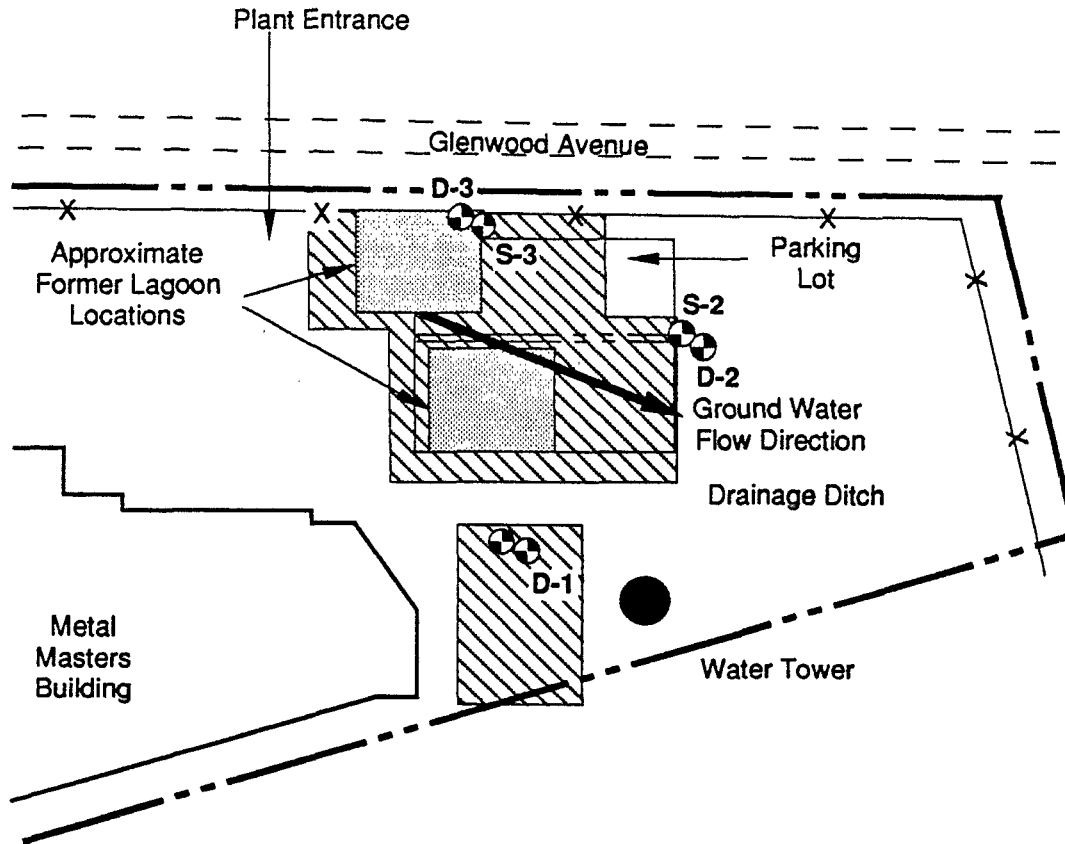
EM methods are sensitive to the presence of areas of anomalous soil conductivity. Each EM measurement encompasses a relatively large volume of subsurface material that enables a bulk electrical characterization to be determined. In this manner, changes in soil conductivity may be measured and inferences made regarding fluid type, total solids concentration, porosity, or lithologic makeup.

Electromagnetic conductivity surveying operates in accordance with the theory of electromagnetic induction. The conductivity of the soil or subsurface materials is determined by measuring the response of the ground to an induced magnetic field. Eddy currents generated by the EM unit create a secondary magnetic field in the subsurface from which the quadrature components of the EM field may be measured. Factors affecting in-situ soil conductivity include matrix porosity, moisture content, clay content, and the conductivity of subsurface fluids. Former excavations may be detected through measurement of lateral variations in soil conductivity.

A Geonics EM31 terrain conductivity meter will be used to perform this investigation. This instrument has an effective penetration depth of 18 feet when operated in the vertical dipole mode. The EM31 will be calibrated at an off-site background reference station prior to commencement of field operations. Based upon surface observations and lateral screening, this reference station will be chosen so as to be free of cultural or environmental interference.

The quadrature data will be presented in the form of two-dimensional color contour plots for each area of investigation.

# Figure 2-1 Tentative Electromagnetic Survey Area Tyler Refrigeration Pit Superfund Site Smyrna, Delaware



## Legend:

- Existing Monitoring Well
- Electromagnetic Survey Area

WO# C27.01	Drawn By / Date: A. Della Camera 2.22.91 Revised By / Date: P. Kryven 11/12/91	Checked By / Date: M. Schmittle 2.22.91 Checked By / Date: E. Sullivan 11.12.91	
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*Interpreted boundaries of the former lagoons will be annotated on the figures.*

## **2.2 Continuous Water Level Study**

Water levels are to be continuously monitored in wells S-2, S-6, D-2 and D-6 and, *if possible, in Smyrna Well No. 1* over a period of 8 days. *This monitoring is intended to verify the results of previous monitoring that indicated that no cycling effect was present from the pumping of Smyrna's municipal water supply wells and to estimate the catchment area of Smyrna Well No. 1 if possible.* Hermit® data loggers will be set up with one pressure transducer installed in each well. Data acquisition will be set for a linear rate, at 10-minute intervals. The date and time the logger is activated will be noted in the field note book, along with two or three hand-measured water levels (electric water level indicator) taken at least 30 minutes apart to calibrate the levels measured by the transducer. Manual measurements will also be made *in all site monitoring wells* in the middle of the 8-day interval and at the end of monitoring before the logger is deactivated.

A continuous recording barometer and a precipitation gauge will also be set up at the Site during the 8-day monitoring period. This data will be used in evaluating any pattern of water level change observed. Precipitation data will be obtained from the nearest meteorological station and compared with the totals measured on Site.

## **2.3 Soil Boring Program**

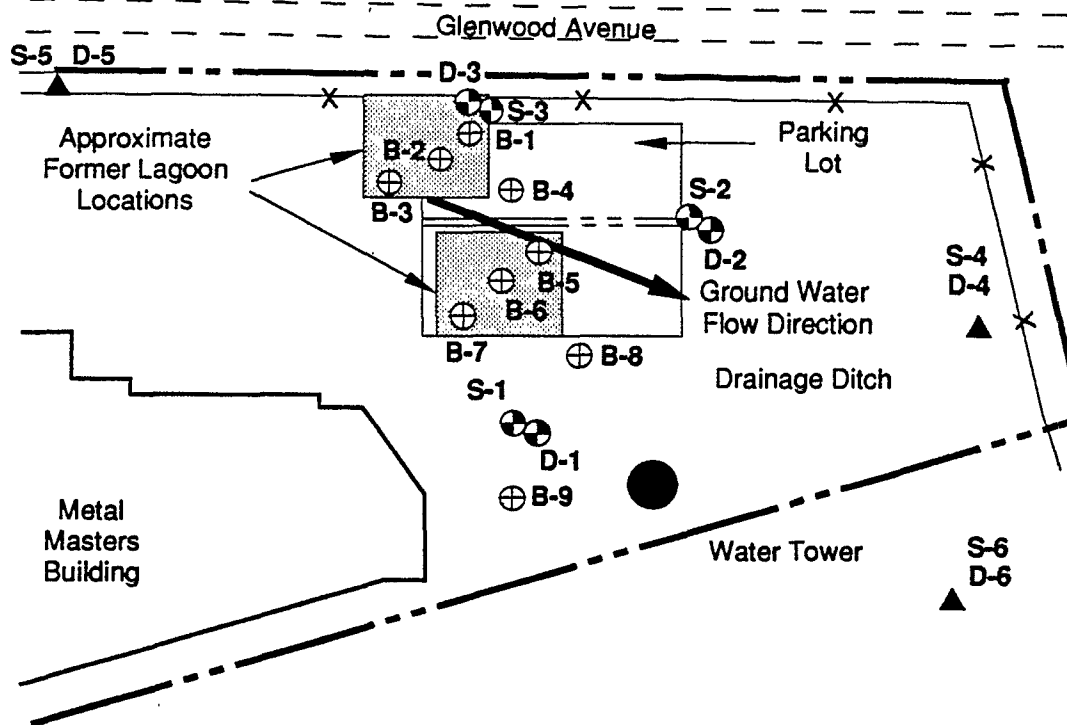
### **2.3.1 Objectives and Scope**

The objectives of the soil boring program are: 1) to determine the vertical extent of substances of concern, if any, within and below the excavated former lagoons; and 2) to evaluate the potential for vertical migration of substances of concern to ground water.




Three soil borings will be completed in each of the two former lagoons *and one boring will be completed adjacent to each lagoon.* These borings will be designated B-1 through B-8 as shown in Figure 2-2. *In addition, one boring (B-9) will be located within the area of the unidentified feature identified by EPA in the 1954 aerial photograph.* Prior to commencement of drilling activities, these locations will be staked in the field by an ERM geologist. The actual boring locations may vary somewhat from these proposed locations depending on the results of an underground utility investigation to be conducted.


# Figure 2-2 Tentative Monitoring Well and Soil Boring Locations

Tyler Refrigeration Pit Superfund Site  
Smyrna, Delaware



## Legend:

-  Existing Monitoring Well
-  Proposed New Monitoring Well Nest
-  Proposed Subsurface Soil Sample

WO# C27.01	Drawn By / Date: A. Della Camera 2.22.91 Revised By / Date: P. Kryven 11.11.91	Checked By / Date: M. Schmittle 2.22.91 Checked By / Date: E. Sullivan 11.11.91	
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### 2.3.2 Equipment

The following is a list of equipment and documents which will be used in connection with the sampling of subsurface soils:

- Field Sampling and Health & Safety Plans.
- Sample containers.
- Quality Assurance Samples (blanks).
- Chain-of-custody labels, tags, and traffic report forms.
- Log books and indelible ink markers. (This is for recording information pertinent to the sampling procedures used, the location of the samples, and observations on the environmental conditions at the time of sampling.)
- Drill rig-operated sampling devices, i.e., hollow stem augers and split spoon samplers.
- Decontamination solutions/water. (These will be used for decontaminating all equipment that comes into contact with the soils and the inside of the casing or auger flights.)
- Buckets, wash basins, scrub brushes, and sponges. (These will be used for equipment decontamination.)
- A steam cleaner. (This will be used when decontaminating large pieces of equipment such as auger flights.)
- Coolers
- Ice or ice packs
- Self-sealing plastic bags
- Plastic drop cloths
- Deionized (DI) water
- Camera/film. (These are for use in documenting sampling procedures and sample locations.)

### 2.3.3 Sampling Technique

Soil borings will be advanced using 4-inch inside diameter (ID) hollow stem augers. Soil samples will be collected in advance of the drill bit using a 2-inch or 3-inch diameter by 2-foot long split spoon sampler. Split spoon samples will be collected continuously from the ground surface to the water table. Each split spoon will be described by an ERM geologist according to the Unified Soil Classification System.

Each split spoon containing a sample will be laid open on a clean surface and the sample divided in half lengthwise. *The open spoon will be shielded from any wind to avoid loss of volatile constituents.* Soil samples will be collected from the split spoons using either a stainless steel spoon or knife. Half of each sample will be placed into clean laboratory supplied sample bottles for possible laboratory analysis. Soil sample containers used for volatile organic analysis (2-40 ml glass vials with Teflon-lined cap) will be filled completely to minimize any headspace. *The volatiles sample will be collected before samples to be analyzed for other compounds and the sample will be placed into the sample vials in a manner to minimize disturbance of the sample material and loss of VOCs.* Samples to be analyzed for TCL SVOA, pesticide/PCB, TAL metals and cyanide will be placed in a 1 liter glass wide mouth jar with a Teflon-lined lid. The sample bottle(s) will then be labeled and placed into an ice chest filled with ice or chemical ice packs to maintain the temperature at approximately 4° C.

The remaining half of each split spoon sample will be placed into a 4-ounce wide mouth jar with a pre-drilled 3/8" hole in the cap. The jar will be partially filled to allow a head space of approximately one inch if possible. After the soil is placed in the jar, the mouth of the jar will be lined with aluminum foil and the cap securely replaced. The jar will be allowed to stand for about 10 minutes to equilibrate the volatile organic compounds from the soil with the headspace air. The sample will be agitated to aid in the volatilization of any substances present. A head space measurement of total volatile organic compounds (VOA) will be obtained by puncturing the aluminum foil seal through the pre-drilled hole with the probe of an Organic Vapor Analyzer (OVA). This measurement will be recorded in the field note book in the drilling log.

*Samples will be obtained from borings B-4 and B-8 for analysis of organic matter content, bulk density, and hydraulic conductivity. Samples for organic matter content and bulk density will be collected in a 1 liter glass widemouth jar. These samples will be obtained from split spoon intervals other than those submitted for chemical analyses in borings B-4 and B-8. Samples for hydraulic conductivity analysis will be obtained by collecting a Shelby tube sample. One sample will be collected for these parameters from each distinct soil material in the unsaturated zone, and from just below the water table for a total of 2 (one unsaturated soil material and one saturated) to 4 (up to 3 different unsaturated materials) samples per each of those two borings.*

*A Shelby tube sample of the clay at the base of the Columbia aquifer will be obtained for particle size and hydraulic conductivity analysis in wells D-4 and D-6.*

#### *2.3.4 Sample Selection and Background Sample*

*One analytical sample will be selected from each distinct material type encountered in each boring. If only one soil type is encountered then two samples will be collected, for a total of two to three analytical samples per boring. The three potential materials that may be encountered are backfill, residual materials left behind from operation of the lagoons and naturally occurring unsaturated soils below or adjacent to the excavated lagoons. Analytical samples will be selected based on the field OVA screening as well as visual classification into one of these categories. If only one soil type is encountered in a boring, samples will be collected using these same criteria, but the samples will be collected from varying depths, if possible, to evaluate vertical differences. If no volatile organic compounds are detected or no visual indicators are present in the soils, an analytical sample will be selected from the deepest unsaturated interval and from an interval closer to the ground surface to evaluate vertical differences.*

*One sample will also be collected and submitted from the first split spoon interval from a boring in each former lagoon to provide data specifically for the Risk Assessment. The boring selected for this sample must be in an unpaved area. If several boring locations are in unpaved areas, the boring centrally located in the former lagoon area will be selected. If a former lagoon is totally covered by pavement, then a surface sample will not be collected from that lagoon area. The sample for VOA analysis will be obtained from the 6-12" interval if possible, and that for the other analyses from the 0-6" interval.*

*One sample will be collected from boring B-9 in the area of the 1954 aerial photograph feature. This sample will be selected on the basis of OVA and visual screening.*

*In addition to the samples collected in and adjacent to the former lagoon area, one soil boring will be completed upgradient of the former lagoon area to provide background data. The background soil boring location will coincide with the upgradient monitoring well location (Section 2.5). Continuous split spoon samples will be collected during borehole advancement for monitoring well installation. Two samples will be selected from this boring for laboratory analysis using the same protocol used for the former*

lagoon area soil borings, (head space readings and visual observations).

*Fifty percent of the subsurface soil samples will be submitted for a complete TCL/TAL analysis (VOA, SVOA, pesticides/PCBs, metals, cyanide) (the Confirmation Suite) to confirm the absence of these substances. These samples will be selected from the former lagoon area on the basis of field observations (elevated OVA readings and/or appearance) with at least one sample per boring being submitted for the Confirmation Suite. The remaining fifty percent of subsurface soil samples will be submitted for TCL VOAs and TAL metals (the Target Substance Suite).*

### *2.3.5 Quality Assurance Samples*

One trip blank will be provided for VOA analyses with each sample shipment in accordance with the QAPP. This blank will consist of DI water in 3-40 ml glass vials. The sample will accompany the other sample containers from the beginning of the task through submission to the laboratory. In addition, one field duplicate will be obtained and analyzed for the same parameters as the sample it duplicates in accordance with the QAPP. The field duplicate will consist of 3 40-ml vials and a 1-liter jar split from a selected field sample. This sample will be randomly selected from among the intervals sampled. A matrix spike and matrix spike duplicate (MSD) set will also be provided to the laboratory for analysis at a rate of one per 20 samples in each sampling media. The MSD set will be obtained by collecting 3 times the volume of soil for organics and 2 times the volume of soil for inorganics. The MSD sample set will consist of 2 40-ml vials (VOAs) and a 1-liter jar (SVOA, pesticides/PCBs, metals, cyanide). Sample containers are shown in Table 1-1. These samples will be labeled as MS/MSD samples and will be given the same sample number as the sample they represent.

The final quality assurance sample will be an equipment rinsate blank. This sample will be obtained by filling containers with final rinsate from a decontaminated split spoon. The rinsate will first be collected in a clean stainless steel bowl, if necessary. The sample will then be poured into an aqueous sample bottle set. The sample will be submitted for a full TCL/TAL analysis as a "soil sample".

The trip blank, equipment rinsate blank and field duplicate samples will receive fictitious identifications that will be recorded with their true identity in the project field book. The MSD set will be labeled with the same number as the respective field sample and identified to the labs.

The *equipment rinsate* blank and MSD set will be analyzed for full TCL/TAL parameters. The travel blank will be analyzed for TCL VOAs only. The duplicate sample will be analyzed for the same parameters as the sample it duplicates.

### 2.3.6 Sample Handling

Sample containers are to be filled in this order:

- VOAs
- SVOAs, pesticides/PCBs, inorganics

Once the analytical samples have been chosen, proper sample packaging, shipping and chain-of-custody procedures will be followed as outlined in Sections 2.6 and 2.7.

### 2.3.7 Decontamination and Disposition of Cuttings

The drill rig and all downhole equipment will be decontaminated prior to initial use and *after use at each* sampling location using the procedures outlined in Section 2.9.1. The split spoon samplers and the sampling implements will be decontaminated prior to initial use and *after* samples are collected as outlined in Section 2.9.2.

The drill cuttings produced during advancement of soil borings will be temporarily stored at the Site in 55-gallon drums. These drums will be clearly labelled with the following information:

- Site name
- Contents, i.e., drill cuttings
- Location, i.e., B-1 etc.
- Date

All drill cuttings will be temporarily staged within the investigation area pending the receipt of results from the soil boring analysis. Following receipt of such analysis, a determination will be made as to the proper method of disposal. *Clark will notify EPA in writing at least 15 days before any scheduled shipment of wastes off-site. This notification will include the name and location of the receiving facility, the type and quantity of waste to be shipped, the expected schedule and the method of transport. All materials will be disposed off site in accordance with applicable laws and regulations.*

*File it  
not 5-12-81*

## **2.4 Surface Soil Sampling Program**

### **2.4.1 Objectives**

The objective of the surface soil sampling program is to assess whether substances of concern are present in surface soils adjacent to the former lagoons in areas not currently covered by the facility parking lot.

### **2.4.2 Soil Gas Survey**

#### **Equipment**

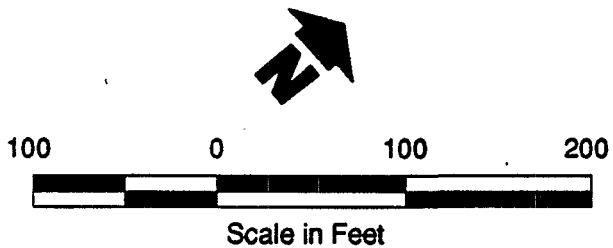
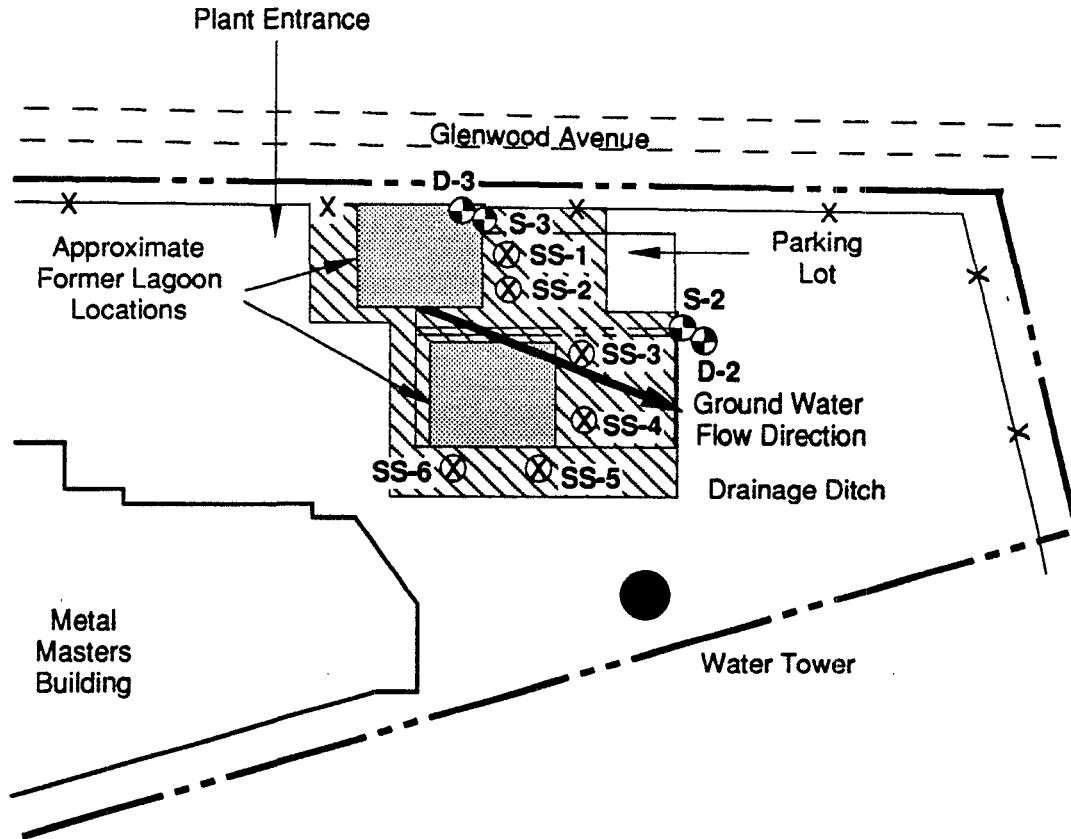
- *Field Sampling and Health and Safety Plans*
- *Soil Gas Probes*
- *Gas Powered Hand Auger*
- *Organic Vapor Analyzer*
- *Portable Gas Chromatograph*
- *Sampling Devices, i.e., Syringes*
- *Log Books and Indelible Ink Markets*
- *Calibration Standards*
- *Decontamination Solutions/Water (These will be used to decontaminate the soil gas probes between sampling points)*

#### **Sampling Procedures**

The soil gas survey will be conducted by establishing a grid with a 30-foot spacing over the area shown in Figure 2-3. Soil gas sampling will be performed by completing one-inch diameter borings at each grid node in unpaved areas to an approximate depth of 24 to 36 inches using a gasoline powered auger. A PVC soil gas probe will be inserted into the boring. (Figure 2-4) The annular space between the probe on the sides of the borehole will be sealed to ensure that soil gas vapors are not lost through this space. A Foxboro Model 128 Organic Vapor Analyzer (OVA) with a flame ionization detector (FID) will be used to draw gas vapors from the soil and register the total VOC concentration from each boring. Both maximum and stabilized VOC readings will be recorded.

Prior to taking a total VOC measurement, background VOCs will be measured in the vicinity of the survey location in the upwind direction and the instrument zeroed to prevent interference. Soil gas will be collected for gas chromatograph (GC) analysis by inserting a Hamilton® gas-tight syringe through the tygon tubing of

# **Figure 2-3** **Tentative Soil Gas Areas,** **and Surface Soil Sample Locations** **Tyler Refrigeration Pit Superfund Site** **Smyrna, Delaware**



**Legend:**

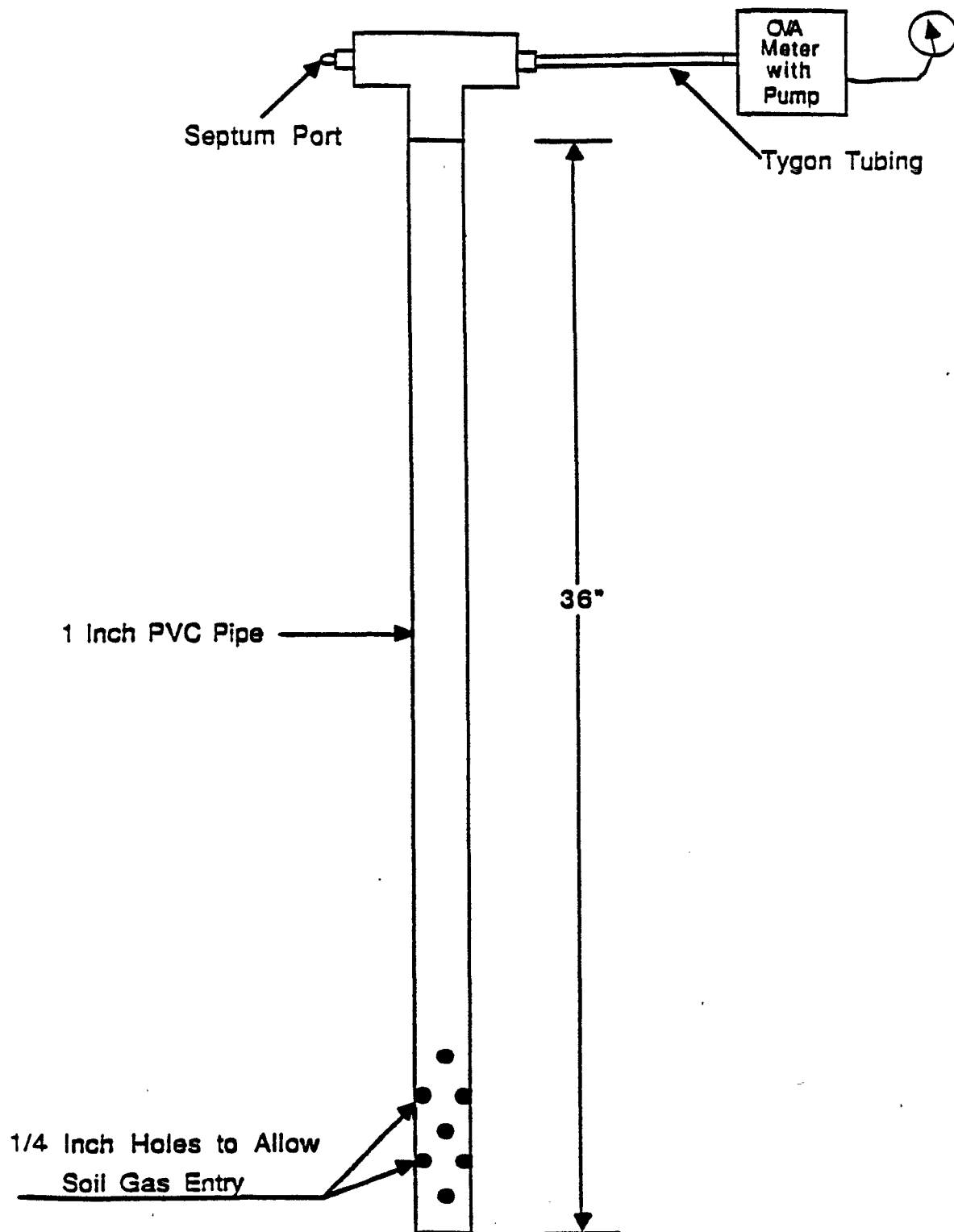
- Existing Monitoring Well
- Soil Gas Survey Area
- Proposed Surface Soil Sample  
 (Two additional samples (SS-7 and SS-8) to be collected from "Hotspots" within Soil Gas Area)


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	Revised By / Date: P. Kryven 11/12/91	Checked By / Date: E. Sullivan 11.12.91



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**Figure 2-4**  
**Soil Gas Probe Schematic**  
 Tyler Refrigeration Pit Superfund Site  
 Smyrna, Delaware



W0# C27.01.01	Drawn by / Date: D. Grabowski 12/31/90	Checked by / Date: E. Sullivan 12/31/90	
	Revised by / Date: P. Kryven 11.11.91	Checked by / Date: E. Sullivan 11.11.91	

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the soil gas probe. An appropriate volume of soil gas (based on the total VOC reading) will be withdrawn from the probe and injected onto the column of a Photovac 10S50 photoionization detector (PID) portable GC. The GC will be equipped with an appropriate length and diameter CSP 20M capillary column to provide separation of TCE, and other chlorinated alkene solvents. Prior to initial use, the GC will be calibrated with 0.5 ppm level standard of each compound for which screening will be performed. However, quantitation limits of the standardized compounds are dependent upon many factors including matrix effects, injection volume, and sensitivity/ionization potential of the detector for each compound.

Sample chromatograms will be compared to the appropriate calibration standard chromatograms to determine whether any of the compounds of interest are qualitatively present based on relative retention time. Each chromatogram will be labeled with the project name, date, time, and sample location. Quantitation for positive identifications is based on the response area ratios of the sample concentration to the standard of known concentration.

A field log will be kept detailing sample injection volumes, analysis run number, response areas for positive identifications and response areas of the compounds in the calibration standard.

#### **2.4.3 Surface Soil Sampling Procedures**

##### **Scope**

Six surface soil samples will be collected from unpaved areas outside the boundaries of the former lagoons. These samples will be evenly spaced along the northeast and southeast sides of the former lagoons approximately 10 feet from the former lagoon boundary. Two additional surface soil samples will be collected from areas showing the highest soil gas readings for a total of eight surface soil samples (Figure 2-3).

##### **Equipment**

The following is a list of equipment and documents which will be used in connection with the collection of surface soil samples:

- Field Sampling and Health & Safety Plans.
- Sample containers.
- Chain-of-custody labels, tags, and traffic report forms.
- Log books and indelible ink markers. (This is for recording information pertinent to the sampling procedures used, the



location of the samples, and information on environmental conditions at the time of sampling.)

- Sampling devices. These include a stainless steel hand bucket auger, stainless steel spoon, and stainless steel hand trowel.
- Decontamination solutions/water. (These will be used for decontaminating equipment that comes in contact with soils.)
- Buckets, plastic wash basins, scrub brushes, and sponges. (These will be used in the cleaning of contaminated equipment.)
- Camera/film. (For use in documenting sampling procedures and sample location.)
- Coolers
- Ice or ice packs
- Self sealing plastic bags
- Plastic drop cloths
- Deionized water

#### Sampling Technique

Surface soil samples will be collected using a stainless steel hand bucket auger. The auger will be advanced to a depth of approximately 1 foot. The sample for volatiles analysis will be collected from the 6 to 12-inch interval and the sample for remaining analytical parameters, depending on the type of analytical suite, will be collected from the 0 to 6-inch interval. The soil samples will be removed from the bucket auger using a stainless steel spoon or trowel and placed into a clean laboratory-supplied sample bottles. Soil sample containers used for volatile organic analysis (2 40 ml glass vials) will be filled completely to minimize any headspace. The sample bottle will then be labelled and placed into an ice chest filled with ice or chemical ice packs. Fifty percent of the surface soil samples will be submitted for full TCL/TAL analysis. The remainder will be analyzed for TCL VOAs and TAL metals.

#### Quality Assurance Samples

Quality assurance samples will be collected at the same rate as for the subsurface soil samples. The equipment rinsate blank and MSD set will be analyzed for full TCL/TAL parameters. The trip blank will be analyzed for TCL VOAs only and the duplicate will be

*analyzed for the same parameters as the sample it duplicates. The equipment rinsate blank will be obtained from the stainless steel hand auger following its decontamination in the same manner as described for the subsurface soil borings in Section 2.3.5. All other sampling, sample container and sample handling protocols will be as described for the subsurface soil samples.*

#### **Decontamination and Sample Handling**

*The bucket auger and spoon or trowel will be decontaminated prior to initial use and after collection of each sample using the procedure outlined in Section 2.9.2. Packaging, shipping and chain-of-custody procedures will be followed as outlined in Sections 2.7 and 2.8.*

### **2.5 Monitoring Well Installation Procedures**

#### **2.5.1 Objectives and Scope**

*The objectives of the monitoring well installation program are to monitor ground water quality in the upgradient and downgradient directions from the former lagoon area and to provide additional data points for the collection of ground water level measurements.*

*Three additional monitoring well clusters will be installed adjacent to the Site at the locations shown on Figure 2-2. One cluster will be installed upgradient of the former lagoon area adjacent to Glenwood Avenue, a second cluster will be installed in the presumed downgradient direction from the lagoons, and a third cluster will be installed downgradient of well cluster S-1/D-1. Each monitoring well cluster will consist of a shallow and a deep monitoring well. The shallow wells, designated S-4, S-5 and S-6, will be screened in the upper 10 feet of the water table aquifer, and the deep wells designated D-4, D-5, and D-6 will be screened in the lower 10 feet of the water table aquifer just above the silt or clay layer which is at the base of the aquifer.*

#### **2.5.2 Drilling Technique**

*The boreholes for well installation will be advanced using 8-inch ID hollow stem augers. If running sands preclude the use of hollow stem augers, the boreholes will be advanced using an 3 1/2-inch diameter mud rotary drill bit. Upon completion of split spoon sampling, this pilot hole will be reamed out with the larger diameter augers prior to setting the well. Samples of the subsurface materials will be collected at 5-foot intervals for the total depth of each boring using a 2-inch diameter by 2-foot long split*

spoon sampler. The split spoon samples will be logged in the field by an ERM geologist according to the Unified Soil Classification System.

### *2.5.3 Cuttings Disposition*

All drill cuttings generated during borehole advancement for monitoring well installation will be temporarily stored at the Site in 55-gallon drums. If the mud rotary drilling method is used, all drilling fluids will also be stored in drums. The drums will be labeled and disposed of as described in Section 2.3.7.

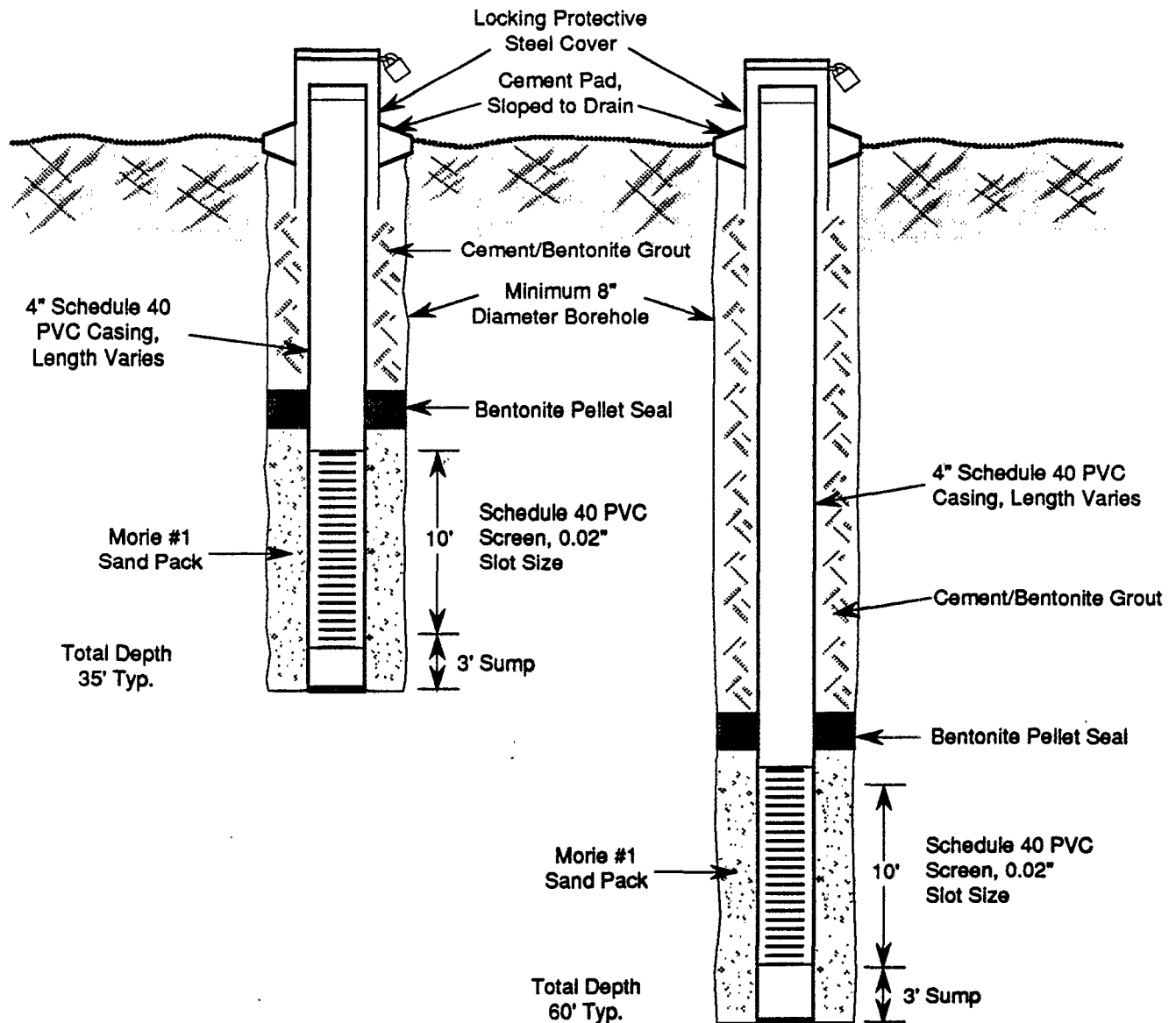
### *2.5.4 Well Construction*


In accordance with DNREC monitoring well specifications, the wells will be constructed of 4-inch diameter, flush threaded Schedule 40 PVC riser and a 10-foot section of 0.02 inch slot PVC screen and a 3' long PVC sump. *The purpose of sump is to allow accumulation of DNAPLs if present.* A No.1 Jessie Morie sand pack will be installed in the annulus to a depth 2 feet above the top of the screened interval. *The 0.02-inch slot PVC screen size and No. 1 Sand pack have been chosen because of the expected coarse grain size of the Columbia Aquifer sediments. The selected slot size and sandpack will allow for the efficient transmittal of water into the well.* A 2-foot thick bentonite seal will be installed on top of the sand pack by dropping bentonite pellets through the annular space between the PVC and the inside of the augers. *If pellets are added at a depth above the water table, then potable water will be added to the borehole and the pellets will be allowed to hydrate for a minimum of 45 minutes before the grout is emplaced. If bridging of the bentonite pellets becomes a problem a bentonite slurry will be tremied into place to provide a seal.* The remainder of the annulus from the top of the bentonite seal to the ground surface will be tremmie grouted using a 95%:5% ratio cement/bentonite grout mixture. The well will be finished with a 6-inch diameter steel protective casing with a locking cap. A schematic diagram of the proposed monitoring well construction is shown in Figure 2-5.

### *2.5.5 Decontamination Procedures*

The drill rig and all downhole tools will be thoroughly steam cleaned prior to drilling at each location *and after the completion of drilling at each location* in accordance to procedures outlined in Section 2.9.1. Prior to installation of each monitoring well, the well casing and screen will be steam cleaned.

# **Figure 2-5** **Proposed Monitoring Well Construction** Tyler Refrigeration Pit Superfund Site Smyrna, Delaware



WO# C2701.00.01	Drawn By / Date: D. Grabowski 2/21/91	Checked By / Date: M. Schmittle 2/21/91	
	Revised By / Date: P. Kryven 11.11.91	Checked By / Date: E. Sullivan 11.11.91	

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### **2.5.6 Well Development**

After well installation is completed, the wells will be developed using the *surge block/pumping method*. The operation of the surge block forces water to flow into and out of the screen to remove fine material from the sand pack and screen. The well is then pumped to remove this fine material. Well development will continue until the discharged water is free of suspended particles. Water removed from the wells during development will be temporarily stored at the Site in 55-gallon drums, which will be labeled as described in Section 2.3.7. The analytical ground water data will be used to determine the proper disposal method for the development water. Off-site disposal will be performed in accordance with applicable laws and regulations. *No water will be disposed of on-site.*

All down-hole equipment used during well development will be steam cleaned prior to insertion into the wells.

## **2.6 Ground Water Sampling**

### **2.6.1 Preparation for Sampling**

Prior to sampling, all wells will be located on a Site map and the order in which each well will be sampled will be determined based on past water quality information. The sampling order will proceed from the least contaminated to most contaminated well. The wells upgradient of the former lagoon area will be sampled first.

### **2.6.2 Equipment**

The following is a list of equipment and documents which will be needed in connection with evacuating and sampling the monitoring wells:

- Field Sampling and Health & Safety Plans.
- Sample containers.
- Coolers and ice (or re-freezable ice packs)
- Meters, probes, and standards for field measurements.
- Quality assurance blanks and deionized water.
- Chain-of-custody labels, tags, and traffic report forms.
- Tape measure graduated in tenths and hundredths of feet.
- Electronic water level indicator.

- Pocket calculator. This will be used for determining the volume of water within the well which, in turn, will be used for calculating the volume of water to be evacuated.
- Log books and indelible ink markers. (This is for recording information pertinent to the sampling procedures used and observations regarding the environmental conditions at the time of sampling.)
- Well evacuation equipment. A submersible pump will be used to purge or evacuate stagnant water in a well prior to obtaining a sample. In the 2-inch diameter wells, a Fultz™ small diameter submersible pump will be used. In the 4-inch diameter wells, a Fultz pump or 2-inch diameter Grundfos™ submersible pump will be used.
- Bottom-loading PVC bailer. The bailer will be used to obtain the ground water sample after the well has been evacuated. One of these bailers will be dedicated to each monitoring well.
- Decontamination solutions/water. (These will be used for decontaminating all equipment that comes into contact with the ground water.
- Buckets and/or graduated plastic pails. These will be used for measuring the flow rate and volume of water evacuated from the well prior to sampling. A low-flow, totalizing meter may also be used.
- Camera/film. (These may be required for documenting sampling procedures and well locations.)
- *Self sealing plastic bags*
- *Plastic drop cloths*

### 2.6.3 Well Evacuation

Prior to evacuating a well, it will be necessary to determine the volume of water being held in the well casing. The calculation of the well volume will be conducted as follows:

1. Determine the static water level. This will be measured to the nearest one-hundredth of a foot below the top of the casing. The water level indicator will be cleaned before use in each well.
2. Calculate the number of linear feet of static water (total depth of the well minus the static water level).
3. Calculate the static volume in gallons ( $\pi \cdot r^2 \cdot h \cdot 7.48 \text{ gal/ft}^3$ ).

Where:

$\pi = 3.14$ ,

r = radius of well in feet,

h = number of linear feet of static water.

A minimum of three well volumes will be evacuated prior to sample collection. The pump will be placed near the top of the water column. This forces water to move up the well casing to the pump; otherwise, water may be removed from the formation only and water standing in the well above the screen may not be evacuated. The flow rate of the pump will be measured using a graduated plastic bucket, or a totalizing flow meter. *While the deep monitoring wells are being purged, the water level in the wells will not be allowed to drop below the top of the screened interval. This will not be possible, however, for the shallow wells because the shallow wells will be screened at the top of the water table aquifer in accordance with DNREC requirements. While purging, the shallow wells will be pumped at a low rate to minimize the disturbance of water within the well.*

Water evacuated from the wells prior to sampling will be temporarily stored at the Site in 55-gallon drums, which will be labelled as described in Section 2.3.7. The analytical ground water data will be used to determine the proper disposal method for the water drawn from the wells as described in Section 2.4.6. *Should low yielding wells be encountered (not expected at this Site), the well will be allowed to recharge overnight after purging. Any such wells will then be sampled the following morning.*

#### 2.6.4 Sample Acquisition

The following procedure will be used for obtaining ground water samples from the monitoring wells associated with the Site.

The pump used to purge the well, and the attached tubing will be removed from the well and decontaminated. Before any samples are collected, the well will be allowed to recover so that there is enough water in it to collect all the necessary sample volume. The bailer used for collecting the sample will be lowered into the well, retrieved, and emptied once to ensure that the bailer has been rinsed of any decontamination fluids. When collecting the ground water needed for filling the sample bottles, the bailer will be gently lowered sufficiently into the water column to collect a sample unaffected by equilibration with the atmosphere (approximately ten feet, if possible), jerked gently to insure the ball valve is closed, and



retrieved at a steady rate to the surface. When transferring the water from the bailer to the sample containers, care will be taken to avoid agitation to the sample which will promote the loss of volatile substances, and promote chemical oxidation. The PVC bailer used to collect the sample at each monitoring well will be dedicated to that well. Each bailer will be decontaminated before and after each use, stored in a polyethylene sleeve and tagged. Bailers will be maintained by ERM for the duration of the RI.

#### *2.6.5 Sample Analytical List and Sample Preparation*

The majority of the ground water samples (S-1, D-1, S-4, D-4, S-5, D-5, S-6, D-6) are to be submitted for *full* TCL/TAL analyses (*Confirmation Suite*). Samples from wells S-1, S-2, S-5 and S-6 will also be analyzed for VOAs by Method 8010 to confirm the absence of low concentrations of chlorinated volatile compounds. *The remainder of the ground water samples (S-2, D-2, S-3 and D-3) will be submitted for the Target Substance Suite.* Sample containers and preservatives are shown on Table 1-1.

Sample containers will be filled in the following order:

- vinyl chloride (VOA) Method 8010
- TCL VOAs
- TCL SVOAs
- TCL pesticide/PCBs
- TAL cyanide
- TAL dissolved metals

All ground water samples *are* to be submitted for dissolved metals analysis. *Samples obtained from each monitoring well* will be filtered using a Millipore® Hazardous Waste Filtration System. A 0.45-micron pore sized membrane will be used for sample filtration. This pressure filter allows for rapid filtration and is constructed of all stainless steel and Teflon materials. An inert nitrogen (N<sub>2</sub>) gas supply is used as the pressure source. Samples being collected for cyanide and organic parameters will not be field filtered.

#### *2.6.6 Quality Assurance Samples*

One *trip* blank will be submitted *per day of sampling* with the ground water samples. *Trip blanks* will consist of deionized water in sample vials for TCL VOA analyses that will accompany all sample containers to the point of submission to the laboratory. A second

set will also be completed for analysis via Method 8010 for vinyl chloride.

A matrix spike/matrix spike duplicate (MSD) set will also be completed *by collecting triple volume* of a field sample. This set will also include a second set of vials for analysis by Method 8010 for vinyl chloride.

An *equipment rinsate* blank will be completed by filling a decontaminated bailer with deionized (DI) water *which will be* transported to the Site in unpreserved one liter glass sample bottles with Teflon-lined lids. Following decontamination, the bailer (noted in field book) will be filled with DI water. The *water in the bailer* will then be *poured into the appropriate* sample containers. The *rinsate* blank for metals analysis will be filtered as described *above* for the dissolved metals analysis.

The *equipment* blank and MSD set will be analyzed for full TCL/TAL parameters and vinyl chloride by Method 8010. The *trip* blank will be analyzed for by both CLP methods and for vinyl chloride by Method 8010. The field duplicate will be analyzed (from well D-1, which has shown the highest metals concentrations) for *full TCL/TAL analysis*. The MSD set will be completed *by collecting triple volume* of the full TCL/TAL sample obtained from S-1 and identified as "S-1 MS" and "S-1 MSD". The field blank and field duplicate will be labeled with a fictitious identity.

#### **2.6.7 Sample Handling**

Upon collection, the samples will be prepared, preserved, and stored in such a manner as to prevent any changes in sample chemistry. Packaging, shipping and chain-of-custody procedures will be followed as outlined in Sections 2.7 and 2.8.

### **2.7 Chain-of-Custody Procedures**

#### **2.7.1 Scope and Objectives**

Once soil or ground water samples have been collected, prepared, preserved, and appropriately stored, they will be packaged for shipment and/or delivery to the laboratory. In addition, from the time of sample collection until the analyses have been completed, chain-of-custody procedures will be followed to ensure the proper handling and possession of the samples. This section outlines general ERM chain-of-custody procedures.

The primary objective of these procedures is to create an accurate written record which can be used to trace the possession and

handling of the sample from the moment of its collection through analysis.

### ***2.7.2 Custody Requirements***

A sample is defined as being in someone's custody if:

- it is in one's actual possession, or
- it is in one's view, after being in one's physical possession, or
- it is in one's physical possession and then stored in a secure facility or location so that no one can tamper with it, or
- it is kept in a secured area, restricted to authorized personnel only.

To help eliminate possible problems in the chain-of-custody protocol, one person will be appointed Field Custodian for the investigation at the Site. The Field Custodian will document each transaction and the sample will remain in his custody until it is shipped to the laboratory.

### ***2.7.3 Sample Labels***

A self-adhesive sample label will be affixed to each container before sample collection. At a minimum, the sample label will contain the information as shown below. Figure 2-6 presents ERM's sample label.

- Client - Job Name
- ERM Traffic Report Number
- Sample identification - place of sampling
- Date and time collected
- Sampler's initials
- Testing required
- Preservatives added

### ***2.7.4 Sample Preparation for Shipment***

After sample collection, each sample *bottle* will be placed in a self sealing plastic bag and placed immediately into an insulated cooler for shipment to the laboratory. ERM field Chain-of-Custody records (Figure 2-7) and an ERM Traffic report (Figure 2-8) completed at the time of sample collection will accompany the samples inside the cooler for shipment to the laboratory. The samples will be



# **Figure 2-6** **ERM Sample Container Label** **Tyler Refrigeration Pit Superfund Site** **Smyrna, Delaware**

Client W.O. #:		Traffic Report #:	
Sample Identification:			
Collection Information:		<input type="checkbox"/> Composite <input type="checkbox"/> Grab	
Date:	Time:	By:	
Testing Required:			
Preservative:			

Environmental Resources Management, Inc.  
 855 Springdale Dr. • Exton, PA 19341 • (215) 524-3500



Client W.O. #		
Traffic Report/Sample I.D.		
Collection Information:		
Date:	By:	Time:
Preservative:		

Environmental Resources Management, Inc. Exton, Pennsylvania • (215) 524-3500

W0# C27.01.01	Drawn by / Date: M.S. Smith 7.1.91	Checked by / Date: E. Sullivan 7.1.91	
	Revised by / Date: P. Kryven 11.11.91	Checked by / Date: E. Sullivan 11.11.91	

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**Figure 2-7**  
**ERM Sample Chain of Custody Form**  
**Tyler Refrigeration Pit Superfund Site**  
**Smyrna, Delaware**



## Sample Chain of Custody

[illegible]

COPIES: White & Yellow copies necessary sample shipped to laboratory. Yellow copy retained by laboratory. White copy to be returned to ERIH for files. Pink copy retained by sampler. Gold copy with copy as needed (see notes)

**W0# C270101**

Drawn by / Date: M.S. Smith 7.1.91

Revised by / Date: P. Kryven 11.11.91

Checked by / Date: E. Sullivan 7.1.91

Checked by / Date: E. Sullivan 11.11.91

**Notes:**



# Figure 2-8

## ERM Traffic Report Form

### Tyler Refrigeration Pit Superfund Site Smyrna, Delaware



## Traffic Report

<b>1</b> Project W.O. Project Name/Location  	<b>2</b> Sample Concentration <input type="checkbox"/> Low Concentration <input type="checkbox"/> Medium Concentration	6425 <b>3</b> Ship to:  																		
<b>4</b> Sample Matrix <input type="checkbox"/> Liquid <input type="checkbox"/> Solid <input type="checkbox"/> Other		<b>5</b> Sampling Personnel Contact Sampler: Project Manager: Phone No. (215) 524-3500    Attn:																		
<b>6</b> Shipping Information (Name of Carrier) (Date Shipped) (Airtel Number)	<b>7</b> Specify Type of Analyses, Number of Containers, Approx. Volume <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;">Analyses / Method Requested</th> <th style="width: 20%;">No. of Bottles</th> <th style="width: 20%;">Total Volume</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>		Analyses / Method Requested	No. of Bottles	Total Volume															
Analyses / Method Requested	No. of Bottles	Total Volume																		
<b>8</b> Sample Location    Date: Time:																				
<b>9</b> Sample Description <input type="checkbox"/> Surface Water <input type="checkbox"/> Soil <input type="checkbox"/> Ground Water <input type="checkbox"/> Solid <input type="checkbox"/> Leachate <input type="checkbox"/> Other: <input type="checkbox"/> Sediment	<b>10</b> Special Handling (e.g. Safety Procedures/Hazardous)  Additional comments: (Specify date postage, rush work, special detection limits, etc.)																			
<b>11</b> Condition of Samples Received (to be completed by Laboratory Log-in.) <input type="checkbox"/> Samples received intact <input type="checkbox"/> Samples at 4 degrees (C) <input type="checkbox"/> Samples not leaking <input type="checkbox"/> Container numbers match as specified in item 7 <input type="checkbox"/> Container tags match Chain of Custody <input type="checkbox"/> Cooler received with Custody Seals intact <input type="checkbox"/> Samples contained within plastic bags																				
Log-in Person's Signature  																				

Copies: White & Yellow copies accompany sample shipment to laboratory. Yellow copy retained by laboratory. White copy to be returned to ERM for file. Pink copy retained by sampler. Gold copy kept as needed (warehouse).

W0# C27.01.01	Drawn by / Date: M.S. Smith 7.1.91	Checked by / Date: E. Sullivan 7.1.91	
	Revised by / Date: P. Kryven 11.11.91	Checked by / Date: E. Sullivan 11.11.91	

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properly relinquished on the field Chain-of-Custody record by the Field Custodian. These record forms will be sealed in a ziplock plastic bag to protect them against moisture. Each cooler will contain sufficient ice and/or ice packs to ensure that proper temperature is maintained, and will be packed in a manner to prevent damage to sample containers. The Field Custodian will initial and custody seal (Figure 2-9) each sample cooler. *Custody seals will be placed over the front lid and over the back lid opening. Packing tape will be placed on top of each custody seal and wrapped completely around the cooler to secure the lid.* All coolers will be shipped by an overnight courier according to current US DOT regulations. Prior to releasing the coolers, the Field Custodian will require the courier to sign an ERM Cooler Transfer Acknowledgment (Figure 2-10). Upon receiving the samples, the laboratory Sample Custodian must inspect the condition of the samples, compare the information on the sample labels against the field Chain-of-Custody record and Traffic Reports, assign a Laboratory control number, and log the control number into the computer sample inventory system.

#### **2.7.5 Sample Log-in**


The Laboratory Sample Custodian will note any damaged sample containers or discrepancies between the sample label and information on the field Chain-of-Custody record when logging the sample and will note any discrepancies in Section 11 of the ERM Traffic Report. This information must also be communicated to the Field Custodian so proper action can be taken.

#### **2.8 Packaging and Shipping Procedures**

All individual sample containers will be placed in a metal or molded plastic insulated cooler. The following is an outline of the procedures that will be followed:

- Using shipping tape, the drain plug at the bottom of the cooler will be secured to ensure that water from potential sample container breakage or ice melting does not leak from outside of the cooler.
- The bottom of the cooler will be lined with a layer of vermiculite sufficient to absorb any potential spillage.
- Screw caps will be checked for tightness and each container will be placed in individual ziplock plastic bags. All sample containers will be placed in the cooler.

**Figure 2-9**  
**ERM Custody Seal**  
Tyler Refrigeration Pit Superfund Site  
Smyrna, Delaware

	<b>OFFICIAL CUSTODY SEAL</b>	Name _____
		Date _____

W0# C27.01.01

Drawn by / Date: M.S. Smith 7.1.91

Checked by / Date: E. Sullivan 7.15.91

Revised by / Date: P. Kryven 11.11.91

Checked by / Date: E. Sullivan 11.11.91



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## ERM COOLER TRANSFER ACKNOWLEDGEMENT

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Checked by / Date: E. Sullivan 11.11.91



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- For all containers, vermiculite must be used to keep containers in place and to prevent breakage.
- Ice sealed in plastic bags or ice packs will be placed in the top of the cooler in order to keep samples at 4°C.
- All remaining space in the cooler will be filled with vermiculite.
- Documents (Chain-of-Custodies and Traffic Reports) accompanying the samples will be sealed in a ziplock plastic bag and attached (taped) to the inside of the cooler lid.
- The lid of the cooler will be closed and fastened.
- Shipping tape will be used to seal the space between the lid and the cooler. The tape will be wrapped around the cooler several times to ensure that the lid does not open if the latch becomes unfastened. The custody seal will be affixed to the cooler and taped so any potential tampering can be detected.
- The following information will be attached to the outside of the cooler: name and address of receiving laboratory with return address, arrows indicating "This End Up" on all four sides, and "This End Up" label on the top of the lid.
- Additional labels such as "Liquid in Glass" are optional. If the bottles have been carefully packaged, additional warnings should not be needed.

## 2.9 Equipment Decontamination

### 2.9.1 Drilling Equipment Decontamination

Drilling equipment will be decontaminated prior to initial use, between boring and monitoring well locations, and at the completion of drilling activities. Items necessary to decontaminate will include:

- back of drilling rig
- auger flights
- down-hole equipment
- well casing and screen

A manual scrubbing to remove foreign material followed by a thorough steam cleaning will be used for decontamination of the above items. Drilling equipment, well screen, and well casing will



be stored in a contaminant-free location above ground on wooden supports after decontamination, and covered with plastic until use.

All drill rig decontamination will take place at a predetermined decontamination area which will be established at the Site. All water used for decontamination will be temporarily stored in clearly labelled 55-gallon drums at the Site. Decontamination water will be disposed of in the same manner as described for purge and development waters.

### *2.9.2 Sampling Equipment Decontamination*

All non-disposable equipment used for the collection, preparation, preservation, and storage of the environmental samples will be cleaned prior to their use and after each subsequent use.

The procedure to be used to decontaminate non-disposable sampling equipment (such as bailers, stainless steel spoons and trowels, and other apparati that come into direct contact with the samples) is described below:

- Manual scrub with a non-phosphate detergent (steam clean if necessary).
- Rinse with tap water.
- Wash or rinse through the use of a squirt bottle with dilute (5-10%) nitric acid.
- Rinse with pesticide-grade methanol.
- Rinse three times with deionized/distilled water.
- Air dry equipment.
- *Rinse with deionized/distilled water.*

The small-diameter evacuation pumps will be decontaminated with the use of two specially-designed decontaminated tanks. These tanks are constructed of a three-foot section of four-inch I.D. PVC pipe with an end cap placed on one end. The pump will be set inside one tank along with three to five gallons of clean tap water. By pumping the clean tap water from the tanks, both the outside and inside of the pump will be decontaminated. After the tap water wash, the pump will be appropriately cleaned as per the above procedures using deionized/distilled water and the second tank.

*The submersible pump will be decontaminated between wells by flushing with approximately 50 gallons of clean tap water. The outside of the pump, discharge tubing and power line will be*

*thoroughly rinsed with distilled water using a hand held pressure sprayer.*

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AR300474



Date of QAPP Revision (No. 1)  
11 November 1991

**QUALITY ASSURANCE PROJECT PLAN (QAPP)  
FOR THE  
REMEDIAL INVESTIGATION/FEASIBILITY STUDY  
AT THE  
TYLER REFRIGERATION PIT SUPERFUND SITE  
SMYRNA, DELAWARE**

15 July 1991

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David Steele, C.P.S.S.  
Project Manager

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US EPA Project Manager

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FILE: C27-01-01-01



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## SECTION 1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been developed to present the quality assurance measures that will be used during the Remedial Investigation/Feasibility Study for the Tyler Refrigeration Pit Superfund Site (hereinafter designated as the Site) located in Smyrna, Delaware. This QAPP has been prepared based on guidance presented in the "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80" and EPA NEIC Policies and Procedures Manual, dated May 1978, revised May 1986, EPA document 330/9-70-001-R. The objectives for the Remedial Investigation/Feasibility Study are outlined in the Work Plan.

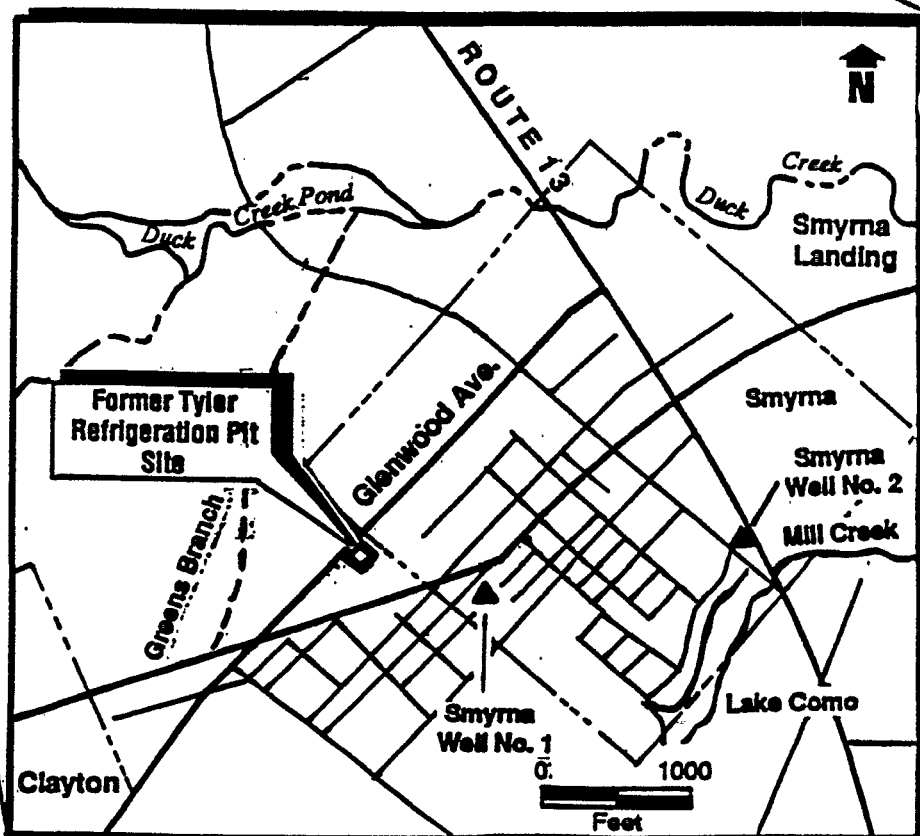
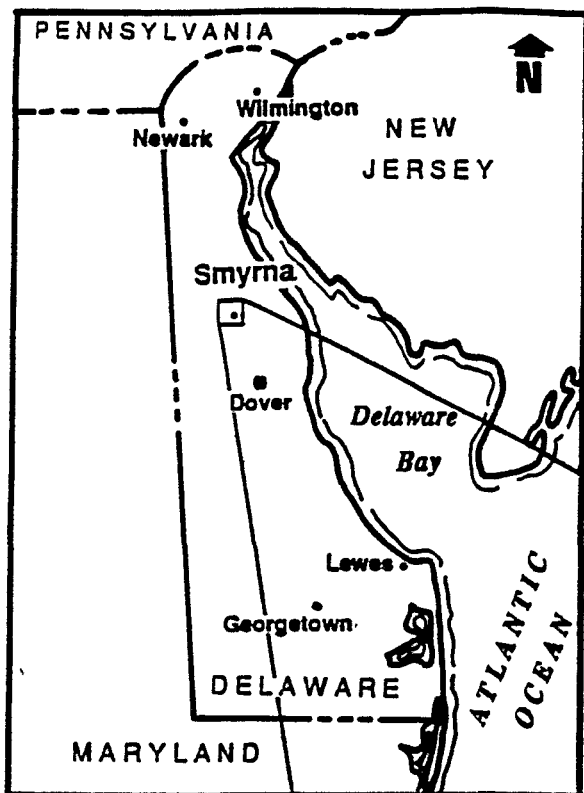
### 1.1 Site Background and Regulatory Status

The Site is a former lagoon area located at 655 Glenwood Ave, Smyrna, Delaware (Figure 1-1). The Site is situated on a parcel of property that is currently occupied by Metal Masters Food Service Equipment Company, Inc., but was formerly owned by the Tyler Refrigeration Corporation. The Site is approximately 1/2 mile southwest of the center of the town of Smyrna (population 4750).


The Site consists of an area which formerly contained two wastewater lagoons (or pits). The Site is located in the northeast portion of the Metal Masters property (Figure 1-1). Aerial photographs suggest that the northernmost lagoon was approximately 70 feet x 70 feet in size and the southernmost lagoon was approximately 60 feet x 60 feet. The lagoons apparently received wastewater from manufacturing operations at the property. Based on a review of aerial photographs, the two lagoons were present on the property from as early as July 1954. This review also indicates that sometime between 1973 and 1975, the contents of the lagoons were excavated and removed. The lagoons were subsequently backfilled and regraded. The Site is currently covered by a lawn and an asphalt parking lot for the manufacturing building located on the property.

Little is known regarding the uses of the Site and surrounding property prior to 1946. Beginning in 1949, a plant was operated on the property to manufacture refrigerators. In 1951, Tyler Refrigeration Corporation (Tyler) assumed control of the refrigeration manufacturing operations at

**Figure 1-1**  
**Site Location Map**  
**Tyler Refrigeration Pit**  
**Superfund Site**  
**Smyrna, Delaware**



Source: USGS Topographic Quadrangles, Clayton, & Smyrna, Delaware.

WD# C27.01.01	Drawn by / Date: E. Knopfle 2/20/91	Checked by / Date: M. Schmittle 2/20/91	
	Revised by / Date: M.S. Smith 6.27.91	Checked by / Date: E. Sullivan 6.27.91	

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the property. According to aerial photographs, sometime prior to July 1954, two lagoons were constructed in the northeast portion of the property. In 1963, Tyler transferred the property to Clark as part of a transaction whereby Tyler became a part of the refrigeration division of Clark. Clark manufactured refrigeration-related equipment at the property until approximately 1976.

According to NUS ("A Field Report for Tyler Refrigeration" 1986), wastewater discharges from manufacturing process were connected to a municipal sewage system in 1969. In addition, aerial photographs indicate that sometime between 1973 and 1975, the contents of the lagoons were excavated and removed. Lagoon materials and or soils were reportedly removed to a depth of approximately 20 feet.

In 1978, the property was purchased from Clark by Metal Masters. Metal Masters has been manufacturing food service equipment at the property since 1978.

In 1982, EPA commissioned Ecology and Environment, Inc. ("E&E") to perform a Preliminary Assessment/Site Investigation in connection with the Site. 1,1,1-trichloroethane (TCA) and 1,1-dichloroethane (DCA) were detected in one of the soil samples collected as a part of this study at concentrations of 15 micrograms per kilogram ( $\mu\text{g/Kg}$  or parts per billion) and 10  $\mu\text{g/Kg}$  respectively. Toluene was detected in a second soil sample at a concentration of 25  $\mu\text{g/Kg}$ .

In 1988, EPA commissioned the Delaware Department of Natural Resources and Environmental Conservation (DNREC) to conduct a further investigation at the Site. Monitoring well nests were installed at three locations and sampled. 1,1,1-TCA was detected in each of the three shallow wells at concentrations ranging from 5 to 110 micrograms per liter ( $\mu\text{g/L}$ ). 1,1-DCE was detected in well S-1 at a concentration of 8  $\mu\text{g/L}$ , and chromium (total) was detected in wells S-2 and D-2 at concentrations of 19 and 113  $\mu\text{g/L}$ , respectively. These substances are near or well below the maximum contaminant levels (MCLs) set under the Safe Drinking Water Act.

EPA added the Site to the National Priorities List (NPL) in February 1990. Although several Potential Responsible Parties (PRPs) have been identified by EPA, Clark Equipment Company (Clark) has agreed to enter into an Administrative Order on Consent (AOC) with EPA to conduct a RI/FS for the site.

## SECTION 2 PROJECT ORGANIZATION AND RESPONSIBILITIES

While all personnel involved in an investigation and in the generation of data are implicitly a part of the overall project and quality assurance program, certain individuals have specifically designated responsibilities. Within ERM, these individuals are the Project Director, the Project Manager, the Quality Assurance Coordinator, the Quality Assurance Chemist, the Laboratory Coordinator, the Project Geologist, and the Project Technicians. A project organization chart is presented in Figure 2-1.

CHESTER LabNet, of Houston, Texas, will provide all analytical services for this investigation. Specific laboratory personnel with quality assurance/quality control responsibilities include the Laboratory Quality Assurance Officer and Laboratory Sample Custodian.

### 2.1 Project Director

Mr. Alan Funk, P. G. will be the Project Director for the RI/FS at the Site. The Project Director is responsible for the overall quality of the project. The Project Director is an experienced manager and technical professional who provides QA review, assists in the coordination of the RI, participates in the major meetings and regulatory negotiations, and serves as an upper level ERM contact for the client.

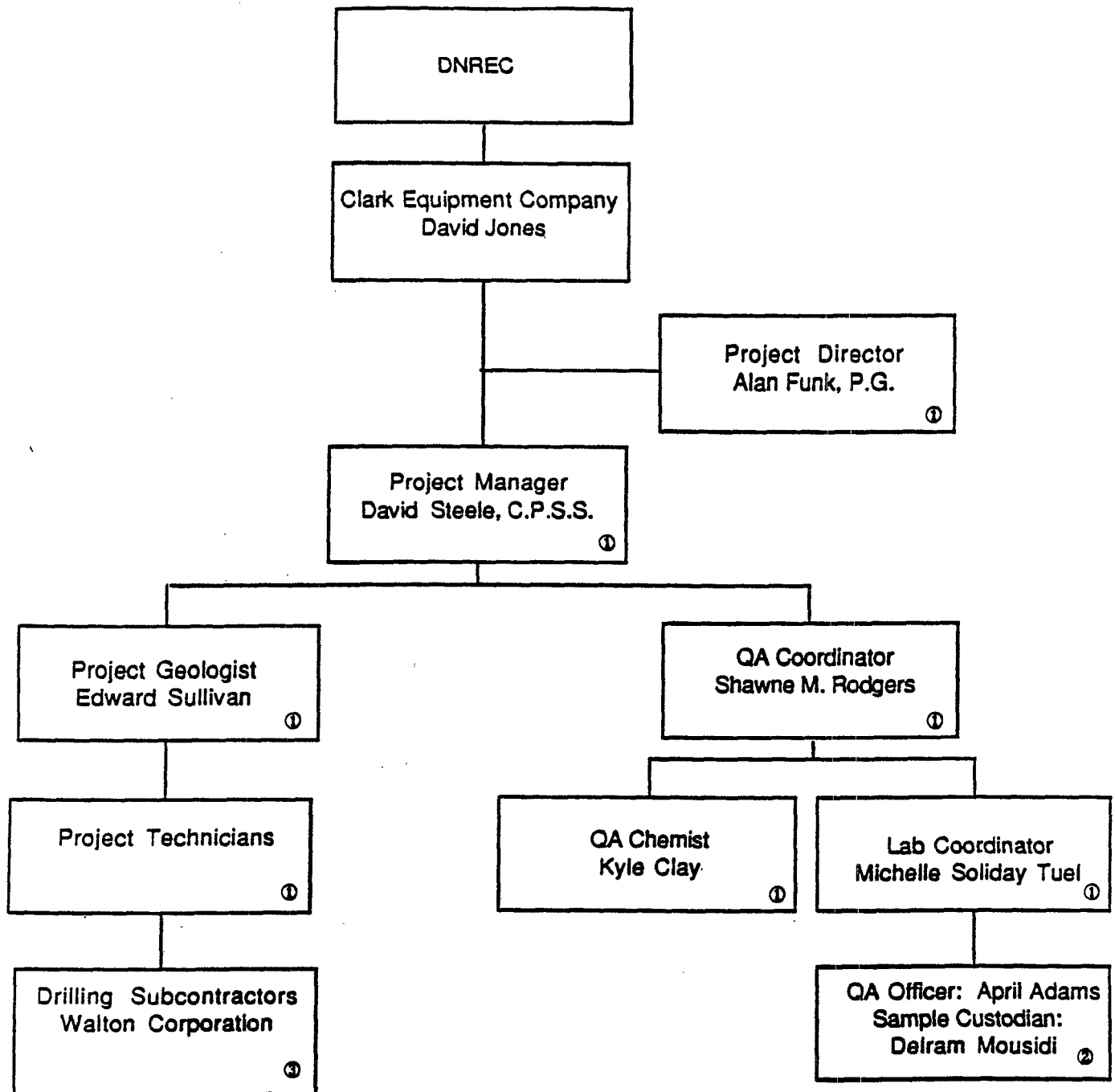
### 2.2 Project Manager

Mr. David Steele, C.P.S.S., will be the Project Manager (PM) for the RI/FS at the Site. The PM will be responsible for oversight and coordination of the various elements of the RI/FS.

The PM will maintain routine contact with the investigation's progress, and will regularly review the project schedule. The PM will help prepare and review all major work elements prior to submission to the Project Director. The PM will serve as the prime contact with Clark and governmental agencies. Mr. Steele will also manage the budget for the project.

Figure 2-1  
Project Organization  
Remedial Investigation

Section: 2  
Revision No: 1  
Date: 11 November 1991



① Environmental Resources Management, Inc.  
855 Springdale Drive  
Exton, PA 19341 (215) 524-3500

② CHESTER LabNet  
8300 Westpark Drive  
Houston, Texas 77063 (713) 266-6800

③ Walton Corporation  
Paper Mill Road  
Newark, DE 19715 (302) 737-6480



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### **2.3 Quality Assurance Coordinator**

Ms. Shawne M. Rodgers will serve as the Quality Assurance Coordinator on all project aspects requiring the collection of data, and as such will not be directly involved in the routine performance of technical aspects of the RI/FS.

The Quality Assurance Coordinator responsibilities will include the development, evaluation, and documentation of the Quality Assurance Project Plan and procedures appropriate to the investigation. Additional responsibilities will include reviewing project plans and revising the plans to ensure proper quality assurance is maintained. The Quality Assurance Coordinator will also be responsible for all data processing activities, data processing quality control, and final analytical data quality review. The Quality Assurance Coordinator will provide final review of all Tentatively Identified Compound (TIC) mass spectra matching quality.

In addition to the above responsibilities, the Quality Assurance Coordinator will ensure that all personnel have an understanding of the project quality assurance plan, an understanding of their respective roles relative to one another, and an appreciation of the importance of the roles to the overall success of the program.

### **2.4 Quality Assurance Chemist**

Mr. Kyle Clay will serve as the Project Quality Assurance Chemist. The Quality Assurance Chemist will have primary responsibility for analytical data validation and review. In this capacity, the Quality Assurance Chemist will prepare analytical quality assurance reports describing data usability and analytical quality control problems discovered during the course of the data validation.

### **2.5 Laboratory Coordinator**

Ms. Michelle Soliday Tuel will serve as ERM's Laboratory Coordinator with the primary responsibilities of coordinating communication between the project team and the subcontracted laboratory. Her duties will include scheduling analytical services and informing the laboratory of sample shipment and expected receipt dates; issuing ERM chain-of-custody and traffic report forms; tracking, logging, and filing documentation returned from the laboratory; and routing analytical data to the Quality Assurance Coordinator for validation review.

## **2.6 Project Geologist**

Mr. Edward Sullivan, will serve as the Project Geologist for this project. The Project Geologist will be responsible for all soil boring and well installation tasks and for the day-to-day activities of ERM field personnel. The Project Geologist will be responsible for field quality assurance and other non-analytical data quality review. Additional responsibilities of the Project Geologist include the verification for accuracy of field notebooks, driller's logs, chain-of-custody records, sample labels, and other field-related documentation.

## **2.7 Project Technicians**

Sampling tasks required by this project will be conducted by experienced environmental geologists and technicians. Their responsibilities will include the documentation of the proper sample collection protocols, sample collection, field measurements, equipment decontamination, and chain-of-custody documentation.

## **2.8 Laboratory Quality Assurance Officer**

The volume of analytical work for this project necessitates that the subcontracted laboratory designate a Quality Assurance Officer whose duties are specific to the project. Ms. April Adams will serve as CHESTER's Quality Assurance Officer with the responsibility for maintenance of laboratory quality assurance activities in association with the project.

## **2.9 Laboratory Sample Custodian**

Ms. Delram Mousidi will serve as CHESTER's Sample Custodian. The Sample Custodian's responsibilities include ensuring proper sample entry and sample handling procedures by laboratory personnel.

### **SECTION 3**

## **QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, REPRESENTATIVENESS, COMPARABILITY, AND COMPLETENESS**

### **3.1 Overall Project Objectives**

Data Quality Objectives (DQOs) are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision-making process. DQOs define the total uncertainty in the data that is acceptable for each specific activity during the investigation. This uncertainty includes both sampling error and analytical error. Ideally, zero uncertainty is the intent; however, the variables inherently associated with the process (field and laboratory) contribute to uncertainty in the data. It is the overall project objective to keep the total uncertainty within an acceptable range that will not hinder the intended use of the data. In order to achieve this objective, data quality requirements such as quantitation limits, criteria for accuracy and precision, sample representativeness, data comparability, and data completeness have been specified. The overall data quality objectives and requirements will be established such that there is a high degree of confidence in measurements performed during the project. The data collected during the course of the investigation will be used to answer the following questions:

1. Are substances of concern present or absent (qualitatively)?
2. What quantities (concentrations) of substances of concern are present (quantitative)?
3. What are the impacts of potential concern?
4. What are the characteristics of the pathways of migration?
5. What degree of reduction in concentrations of substances of concern will mitigate the impacts of concern?

The media that will be sampled to answer these questions will be ground water, surface soil, and subsurface soils.

As stated earlier, the parameters that will be used to specify data quality requirements and to evaluate the analytical system



performance are precision, accuracy, representativeness, completeness, and comparability (PARCC). Table 3-1 presents definitions for these parameters.

### 3.2 Field Investigation Quality Objective

The objective with respect to the field investigation is to maximize the confidence in the data in terms of PARCC.

Section 9 presents the frequency with which trip blanks, field duplicates, field blanks, equipment rinsate blanks, and matrix spikes will be collected such that a specific degree of precision and accuracy can be calculated. The data quality objective for field duplicates is to achieve precision equal to or greater than the objectives summarized on Table 3-2.

Precision will be calculated as the relative percent difference (RPD) if there are only two (2) analytical points, and as relative standard deviation (RSD) if there are more than two (2) analytical points. The submission of trip blanks and field blanks will provide a check on accuracy. Although accuracy is best assessed by evaluating the results of blanks, blanks do not monitor analyte losses. The submission of blanks will, however, monitor contaminants introduced with the sampling process, preservation, handling, shipping, and the analytical process. The data quality objective for trip blanks and field blanks is to not exceed the contract required quantitation/detection limit (CRQL/CRDL) for US EPA CLP analyses, and to not exceed the quantitation limit (QL) for non-CLP analyses. In the event that the blanks are contaminated and/or poor field duplicate precision is obtained, the associated data will be qualified as described in Section 12.3. Through the submission of field QC samples, the distinction can be made between laboratory problems, sampling technique, and sample matrix variability.

Precision and accuracy for the field pH and conductivity measurements are dependent on the type and condition of the instrument used and the care used in the standardization and operation. The precision and accuracy objectives for the instrumentation used are as follows:

- pH precision will be  $\pm 0.3$  pH standard units and an accuracy of  $\pm 0.03$  pH standard units. pH measurements will be reported to two (2) significant figures.

**TABLE 3-1**  
**DEFINITIONS OF DATA QUALITY PARAMETERS**

- Precision - a measure of the reproducibility of measurements under a given set of conditions.
- Accuracy - a measure of the bias that exists in a measurement system.
- Representativeness - the degree to which sample data accurately and precisely represent selected characteristics.
- Completeness - a measure of the amount of valid data obtained from the measurement system compared to the amount that is required.
- Comparability - a measure of confidence with which one data set can be compared with another.

**TABLE 3-2**  
**CRITERIA OBJECTIVES**

<u>Precision Objectives</u>	<u>Aqueous</u>	<u>Solid/Other</u>
Field Duplicate/Replicates Blind or labeled)		
TCL VOA	within 20% RPD	within 30% RPD
TCL SVOA	within 20% RPD	within 30% RPD
TCL PCBs	within 25% RPD	within 40% RPD
Metals/Cyanide	within 25% RPD	within 40% RPD
TCL VOA	within 25% RPD	within 30% RPD
Laboratory Duplicates (Unspiked)		
TCL VOA	As specified in current CLP SOW	As specified in current CLP SOW
TCL SVOA	As specified in current CLP SOW	As specified in current CLP SOW
TCL PCBs	within 25% RPD	within 40% RPD
Metals	As specified in current CLP SOW	As specified in current CLP SOW
PPL VOA	Refer to Method SOP in Attachment 2	
Laboratory Duplicate (MSD)		
TCL VOA	As specified in current CLP SOW	As specified in current CLP SOW
TCL SVOA	As specified in current CLP SOW	As specified in current CLP SOW
TCL PCBs	As specified in current CLP SOW	As specified in current CLP SOW
PPL VOA	Refer to Method SOP in Attachment 2	
<u>Accuracy Objectives</u>		
Field or trip blanks		
TCL VOA	Less than the QL	Less than the QL
TCL SVOA	Less than the QL	Less than the QL
TCL PCBs	Less than the QL	Less than the QL
Metals	Less than the QL	Less than the QL
PPL VOA	Less than the QL	

**TABLE 3-2**  
**CRITERIA OBJECTIVES (CONTINUED)**

Accuracy Objectives (cont.)

Laboratory Blanks

TCL VOA	Less than the QL	Less than the QL
TCL SVOA	Less than the QL	Less than the QL
TCL PCBs	Less than the QL	Less than the QL
Metals	Less than the QL	Less than the QL
PPL VOA	Less than the QL	

Matrix spikes/surrogate spikes

All TCL Fractions	As specified in current CLP SOW	As specified in current CLP SOW
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TAL Metals/Cyanide

As specified in current CLP SOW	As specified in current CLP SOW
------------------------------------	------------------------------------

(Pre/Post - digestion  
spikes)

PPL VOA	Refer to Method SOP in Attachment 2
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- Conductivity precision will be  $\pm 3$  umhos/cm on the 500 umhos/cm range,  $\pm 25$  umhos/cm on the 5,000 umhos/cm range, and  $\pm 250$  umhos/cm on the 50,000 umhos/cm range. Accuracy for the conductivity measurements is a function of the conductivity reading for the probe and instrument combined. Conductivity measurements will be reported to one (1) significant figure for values below ten and to two (2) significant figures for values above ten.

To ensure sample representativeness, sample collection will be performed in accordance with EPA-recommended procedures for collection and preservation; EPA-recommended holding times specified in EPA 600/4-79-020 (Methods for Chemical Analysis of Water and Wastes), the Federal Register, 26 October 1984, and EPA SW-846 (Test Methods for Evaluating Solid Waste).

The data quality objective for the completeness of data with respect to the sampling (field investigation) is 100%. In the event 100% is not obtained, the effect of the uncollected data will be evaluated by the Project Manager as to its impact (if any) on project objectives. Corrective actions will be initiated to resolve any data gaps from the original objectives, found as a result of less than 100% data completeness. Every effort will be made to obtain valid data for all sampling points, particularly those considered to be critical points. In this regard, the critical point samples which are identified will necessarily be selected as subsequent QC samples (duplicate and matrix spikes) at the frequency specified in Section 9.

In order to establish a degree of comparability such that observations and conclusions can be directly compared with all historical data, ERM will use standardized methods of field analysis, sample collection, holding times, and preservation. In addition, field conditions will be considered in evaluating sampling results in order to attain a high degree of data comparability.

### 3.3 Laboratory Data Quality Objectives

The laboratory will demonstrate analytical precision and accuracy by the analysis of laboratory duplicates and matrix spike duplicates. Precision (as well as instrument stability) will also be demonstrated by comparison of response factors for calibration standards. Laboratory accuracy will be demonstrated by the addition of surrogate and matrix spike compounds. Accuracy will be presented as percent recovery. Precision will be presented as relative percent differences (RPD),



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relative standard deviation (RSD), or percent difference (PD), whichever is applicable to the type of QC samples involved. Laboratory method blanks will also demonstrate accuracy with respect to the analyses. The frequencies of laboratory duplicates, matrix spikes and laboratory blanks are specified in the laboratory's Quality Assurance Plan and their method SOP. As considerable reference is made to Attachment 1 in the remainder of this QAPP, it is suggested it be reviewed at this time. Attachment 1 is CHESTER LabNet's (CHESTER) Quality Assurance Plan. CHESTER's laboratory method SOP for Priority Pollutant List (PPL) volatiles is included in Attachment 2.

The analytical laboratory will be expected to process (purge, extract, distill or digest) an aliquot of sample such that the analytical results will provide a high degree of representation with respect to the sampling point. In addition, the analytical laboratory will be expected to document all analytical problems encountered during the course of the investigation. Communication will be maintained with the laboratory so that analytical problems encountered with critical sample points will allow these samples to be re-collected, if necessary. Further, the laboratory will be required to provide all data packages in the current CLP and CLP-Equivalent deliverable formats to ensure that analytical methods, parameters, and reporting units are compatible throughout the investigation.

### **3.4 Criteria Objectives**

The quantitative objectives (criteria) that ERM will require for both field and laboratory accuracy and precision are summarized in Table 3-2.

The laboratory will be expected (as an ideal objective) to report the CRQL, CRDL, or QL for the samples in the appropriate statistical reporting units for the analyses. However, it should be noted that actual quantitation limits are sample specific and depend on variables such as dilution factors, sample matrices, percent moisture, and the specific analyte. The data reported at or near the CRQL/CRDL/QL will be handled cautiously since the stated data quality objectives for accuracy and precision may not "translate" well in some situations (i.e., accuracy and precision suffer for results near the quantitation or detection limits, CRQL/CRDL/QL).

### 3.5 Data Management Objectives

It is a data management objective that all aspects of the investigation from sample design, collection, shipment, analysis use/decisions, etc. be performed in conjunction with rigorous QA/QC documentation. The specific details of this documentation can be found throughout this document.

It is expected that, by the design of separate data quality requirements for field sampling and laboratory analysis, clear distinctions can be made such that any problems found in the system can be isolated with respect to the cause. Conversely, the data quality requirements are also designed to provide an indication of the variability inherent to the overall system.

The overall data management objective is to provide a complete data base with a high degree of confidence through the use of a phased approach of sampling, analysis, data assessment (data review), data qualification, and feedback.

## SECTION 4 SAMPLING PROCEDURES

The numbers of samples, locations, and justifications for each sample media to be collected are presented in Section 3 of the type of Work Plan. Procedures associated with the ground water sampling, surface soil sampling, and soil boring sampling are described below as well as in the Field Sampling Plan. Table 4-1 presents a Sample Summary Matrix for the Tyler Remedial Investigation.

### 4.1 Soil Gas Survey Procedures

The Work Plan describes the use of a soil gas survey to help define contaminant source(s) and potentially delineate volatile organic contamination at the site. As weather conditions can influence the results of soil gas measurements, the survey will be conducted under as ideal conditions as possible. The ideal conditions would include ambient temperatures above 40 ° F, low humidity, and a stable atmospheric pressure system. These conditions may not be able to be met because of seasonal weather conditions. All weather conditions will be recorded during the length of the soil gas survey.

One-inch borings will be drilled to an approximate depth of 3 feet using a gas powered auger. A soil gas probe designed as depicted in Figure 4-1 will then be inserted into the boring and the annulus at the surface sealed. The fit between the probe and the boring is sufficiently tight to ensure that soil gas vapors enter only through the drilled holes and bottom of the soil gas probe. The measurement probe of a FID Organic Vapor Analyzer (OVA) is then connected to the tygon tubing of the soil gas probe. The pump of the OVA is used to draw gas vapors from the soil and the maximum reading is recorded for each boring. In addition to the maximum reading being measured, the stabilized VOC reading will be recorded.

Prior to taking a measurement, background VOCs will be measured at the vicinity of the survey location and recorded.

Each survey location will be analyzed for vinyl chloride, trichloroethene, and 1,1- dichloroethene using a Photovac® 10S70 gas chromatograph (GC). Soil gas for GC analysis will be collected by inserting a Hamilton gas-tight syringe through the tygon tubing of the soil gas probe at the time that the maximum VOC reading is reached.



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Table 4-1  
Ground Water Sample Matrix Summary  
Tular Basin/California Pit Superfund Site RUCS

Section: 4  
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Matrix	Number of Samples*	Number of Trip Blanks**	Number of Equipment (Field) Blanks	Number of Blind Duplicates	Number of Matrix Spike/Matrix Spike Duplicate Samples***	Total Number of Samples	Analytes	Analytical Method	Container and Preservation	Analyte Holding Time****
Ground Water Confirmation Suite	8	1	1	1	2	13	TCL Volatiles	OLM015	2-40 ml clear glass vials w/ Teflon lined enclosure HCL to pH ≤ 2. Cool to 4° C.	14 days
	8	0	1	1	2	12	TCL Semivolatiles	OLM015	2-liter amber glass w/ Teflon lined enclosure. Cool to 4° C.	7 days w/ extraction; analysis w/ 40 days of extract preparation.
	8	0	1	1	2	12	TCL Pesticides/PCBs	OLM015	2-liter amber glass w/ Teflon lined enclosure. Cool to 4° C.	7 days w/ extraction; analysis w/ 40 days of extract preparation.
	8	0	1	1	2	12	TAL Metals (dissolved)	ILM010	1-liter plastic field filtered HNO3 to pH ≤ 2.	7 days w/ extraction; analysis w/ 40 days of extract preparation.
	8	0	1	1	2	12	TAL Cyanide	OLM010	1-liter glass NaOH to pH ≥ 12.	180 days; 28 days for mercury.
Ground Water Target Substance Suite	4	0	0	0	0	4	TCL Volatiles	OLM015	2-40 ml clear glass vials w/ Teflon lined enclosure HCL to pH ≤ 2. Cool to 4° C.	14 days
	4	0	0	0	0	4	TAL Metals (dissolved)	ILM010	1-liter plastic field filtered HNO3 to pH ≤ 2.	180 days; 28 days for mercury.
Ground Water	4	1	1	1	2	9	Vinyl Chloride	8010	2-40 ml clear glass vials w/ Teflon lined enclosure HCL to pH ≤ 2. Cool to 4° C.	14 days

\* The number of samples collected may change based upon decisions made in the field.  
 \*\* Trip blanks will be submitted for volatile analysis at a frequency of 1 per cooler per day.  
 \*\*\* Inorganic analytes will include a single matrix spike and a lab duplicate versus a matrix spike.  
 \*\*\*\* Holding times are from the date of sample collection. The number of trip blanks may change based on time spent in the field.

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Table 4-1 - Cont'd  
Soil Sample Matrix Summary  
Iyler Refinement Pn Superfund Site RUTS

Matrix	Number of Sampler*	Number of Trip Blanks**	Number of Equipment (PMS) Blanks	Number of Blind Duplicates	Number of Matrix Spike/Matrix Spike Duplicate Samples***	Total Number of Samples	Analytes	Analytical Method	Container and Preservation	Analyte Holding Time****
Soil Berings Concentration Berings (Samples will also be collected for the following geochemical testing: grain size, hydraulic conductivity, bulk density, and organic content)	14	1	1	1	2	19	TCL Volatiles	OLM015	3-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	14	0	1	1	2	18	TCL Semivolatiles	OLM015	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days w/ extraction; analysis w/ 40 days of extract preparation.
	14	0	1	1	2	18	TCL Pesticide/PCBs	OLM015	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days w/ extraction; analysis w/ 40 days of extract preparation.
	14	0	1	1	2	18	TAL Metals	ILM010	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days, 28 days for mercury.
	14	0	1	1	2	18	TAL Cyanide	ILM010	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	14 days
Soil Berings Target Substances Sulfide	13	0	0	0	0	13	TCL Volatiles	OLM015	3-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	13	0	0	0	0	13	TAL Metals	ILM010	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days; 28 days for mercury.

\* The number of samples collected may change based upon decisions made in the field.  
\*\* Trip blanks will be submitted for volatile analysis at a frequency of 1 per cooler per day. The number of trip blanks may change based on time spent in the field.  
\*\*\* Inorganic analyses will include a single matrix spike and a lab duplicate versus a matrix spike.  
\*\*\*\* Holding times are from the date of sample collection.

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Table 4-1 - Cont'd  
Soil Sample Matrix Summary  
Tide Refraction PH Superfund Site B/V/S

Section: 4  
Revision: 1  
Date: 11 November 1991

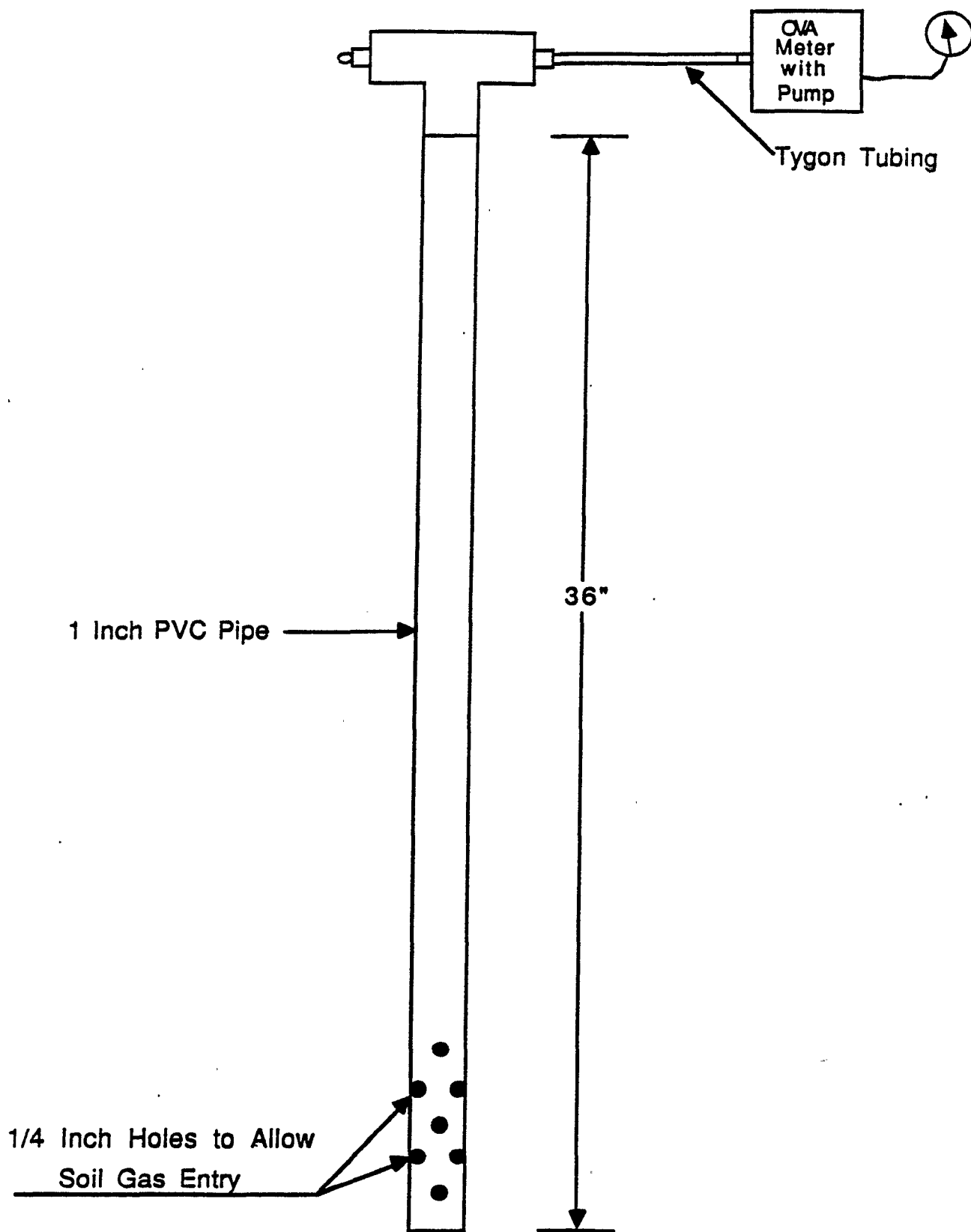
Matrix	Number of Samples*	Number of Trip Blanks**	Number of Equipment (Field) Blanks	Number of Blind Duplicate	Number of Matrix Spike/Matrix Spike Duplicate Samples**	Total Number of Samples	Analyses	Analytical Method	Container and Preservation	Analyte Holding Time***
Surface Soil Confirmation Suite	4	1	1	1	2	9	TCL Volatiles	OLM01.5	3-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	4	0	1	1	2	8	TCL Semivolatiles	OLM01.5	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days in extraction; analysis w/ 40 days of extract preparation.
	4	0	1	1	2	8	TCL Pesticides/PCBs	OLM01.5	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	7 days in extraction; analysis w/ 40 days of extract preparation.
	4	0	1	1	2	8	TAL Metals	ILM01.0	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days; 28 days for mercury.
	4	0	1	1	2	8	TAL Cyanide	ILM01.0	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	14 days
Surface Soil Target Substrate Suite	4	0	0	0	0	4	TCL Volatiles	OLM01.5	3-40 ml clear glass vials w/ Teflon lined enclosure. Cool to 4° C.	14 days
	4	0	0	0	0	4	TAL Metals	ILM01.0	1-liter glass wide mouth jar w/ Teflon lined enclosure. Cool to 4° C.	180 days; 28 days for mercury.

\* The number of samples collected may change based upon decisions made in the field.  
\*\* Trip blanks will be submitted for volatile analysis at a frequency of 1 per cooler per day. The number of trip blanks may change based on time spent in the field.  
\*\*\* Inorganic analyses will include a single matrix spike and a lab duplicate versus a matrix spike.  
\*\*\* Holding times are from the date of sample collection.

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**FIGURE 4-1**  
**Soil Gas Probe Schematic**



An appropriate volume of soil gas will then be withdrawn from the probe and injected onto the column of the Photovac® 10S70 Photoionization Detector (PID) portable GC. The GC will be equipped with a CP Sil 5CB wide bore capillary column. Prior to use, the GC will be calibrated with appropriate levels of vinyl chloride, trichloroethene, and 1,1- dichloroethene as described in Section 7.1.1. Injection volume will be adjusted for the standards and soil gas samples to provide the best achievable sensitivity, typically 50 to 100 ppb. However, quantitation limits are dependent upon many factors, including matrix effects, injection volume, and ionization potential of the detector.

Sample chromatograms will be compared to the appropriate standard chromatograms to determine if vinyl chloride, trichloroethene, and 1,1- dichloroethene are present. Quantitation for positive identifications will be based on the response area ratios for the sample to the working standard. Section 8.1 presents the equation that will be used to calculate sample concentrations and analytical detection limits.

A log will be kept detailing sample injection volumes, analysis run number, response areas for positive identifications, and calibration standard response areas for vinyl chloride, trichloroethene, and 1,1- dichloroethene. Each chromatogram will be labelled with the project name, date, time, and sample location.

## **4.2 Ground Water Sampling Procedures**

Site-specific ground water sampling procedures for the Site are presented in this section. Sampling of the new monitoring wells will not take place until the wells have been properly developed.

### **4.2.1 Preparation for Sampling**

Preparation for sampling includes the acquisition of all necessary monitoring equipment and site-specific information to perform the required monitoring. A location map for the proposed newly installed monitoring wells will be developed before entering the field. Prior to initiating any sampling activities, a complete round of depth to water levels will be measured.

Monitoring wells are to be evacuated and sampled proceeding from the suspected least to most contaminated well to minimize potential cross-contamination. The sampling order of the wells from least to

most potentially contaminated will be based on ground water flow directions, well location with respect to the suspected source areas, historical data, and field OVA readings on soil samples and of the well head during drilling. Total well depths necessary to calculate the required purge volumes will be tabulated after the completion of the installations.

#### 4.2.2 Well Evacuation

Monitoring wells will be evacuated of three volumes of water standing in the well casing or until the well goes dry (for low yielding wells) prior to sample acquisition. The volume of water to be purged for each well will be calculated according to the equation presented below:

$$3 \times (\pi \times r^2 \times h \times 7.48 \text{ gallons/ft.}^3)$$

where:

$$\pi = 3.14$$

r = radius of casing in feet

h = number of linear feet of static water

A stainless steel body, ISCO Model 2600 bladder pump or stainless steel body Fultz electrical submersible pump with polyethylene tubing will be used to evacuate all accessible two-inch monitoring wells. Pump placement depth will be dependent on the well yields. Small diameter pump flow rates are typically low ( $\leq 1.5$  gpm), necessitating placement of the pump intake at the top of the water column in high yielding wells. Low well yields require pump placement to be at the bottom of the well. Proper pump placement will ensure complete and proper evacuation. Upon completion of the required purge volume, the pumping system will be removed from the well. Wells that are inaccessible with the pump system will be hand bailed using a bottom-loading PVC bailer.

Large diameter wells (4" or larger) will be purged using a stainless steel Grundfos® submersible pump fitted with PVC discharge tubing. A check valve placed immediately above the pump prevents purge water in the PVC tubing from re-entering the well when the pump is turned off. Pump placement depth again depends upon well yields (see above paragraph). An Up-Z-Dazy® pump puller is used to install and retrieve the pump in and out of the well.

#### *4.2.3 Sample Acquisition*

Dedicated one-and-one-quarter (1-1/4) inch, bottom-loading PVC bailers will be used to collect grab, ground water samples for transfer into the proper sample containers. Teflon-coated single-strand stainless steel wire or polypropylene monofilament will be used to raise and lower the bailer. Samples will be collected within two hours of well evacuation when at all possible. If well yields are low at the Site, the samples will be collected as the well recovers and provides a sufficient volume of water for sample collection. [Extremely low yielding wells will be given the entire day to recover. Samples will be collected the following day.]

#### **4.3 Surface Soil Sampling**

Surface soil samples will be collected using a hand-driven bucket auger or a stainless steel trowel. The soil sample will be removed from the bucket auger using a precleaned stainless steel scoop or spoon. Soil samples collected using the bucket auger or stainless steel trowels will be placed directly into the sample container. The sample for VOC analysis will be immediately placed in a 4-ounce laboratory cleaned glass jar and packed to minimize headspace. An appropriately sized volume will then be transferred to a one liter laboratory cleaned glass jar for the remaining analyses.

#### **4.4 Soil Boring Procedures**

Soil borings will be installed for the purpose of characterizing the nature of subsurface soils and to collect soil for analysis. Samples will be collected continuously using a split barrel soil sampler driven in advance of the hollow stem auger used to advance the borings. Where split barrel sampling cannot be performed, a bucket auger will be used to collect samples in advance of the hollow stem auger. Each sample will be screened for total organic vapor in the field. Samples with the highest field OVA readings will be selected for laboratory analysis. The soil samples for laboratory analysis will be placed from the split barrel sampler into a laboratory cleaned glass jars using a stainless steel spatula. The sample for VOC analysis will be packed to minimize headspace.

#### 4.5 Decontamination and Post-Sampling Procedures

Decontamination of equipment will take place at a specific decontamination zone designed at the Site.

##### 4.5.1 Drilling Equipment Decontamination

Drilling equipment will be decontaminated prior to initial use, between boring locations, and at the completion of drilling activities. Items necessary to decontaminate include:

- back of drilling rig
- auger flights
- down-hole equipment
- well casing and screen

A manual scrubbing to remove foreign material followed by a thorough steam cleaning will be used for decontamination of the above items. Drilling equipment, well screen, and well casing will be stored in a contaminant-free location above ground on wooden supports after decontamination and covered with plastic until use.

##### 4.5.2 Sampling Equipment Decontamination

All non-disposable equipment (bailers, split spoon samplers, hand trowels, etc.) will be decontaminated according to the procedures summarized below:

- Manual scrub with non-phosphate soap solution plus tap water wash
- Tap water rinse
- 10% nitric acid rinse (for metals only)
- Pesticide grade methanol rinse (for organics only)
- Distilled/Deionized water rinse
- Air dry

Following decontamination, each dedicated bailer will be individually wrapped in plastic liners, sealed, and stored on-site at a contaminant-free location for future use.

The small diameter pump systems (Fultz or ISCO) will be decontaminated before use and between wells with two specially designed decontamination tanks. These tanks are constructed of a three-foot section of four-inch I.D. PVC pipe with an end cap placed on one end. The pump is set inside the first tank along with three to five



gallons of clean tap water. By pumping the clean tap water from the tank, both the inside and outside of the pump and tubing can be decontaminated. After the tap water wash, the pump is placed into a second tank containing three to five gallons of distilled water which is pumped through the system. The outside of the tubing is again thoroughly rinsed with the distilled water.

The submersible pump system will be decontaminated between wells by flushing with approximately 50 gallons of clean tap water. The outside of the pump, discharge tubing and power line will be thoroughly rinsed with distilled water using a hand-held pressure sprayer.

#### *4.5.3 Sample Preparation and Preservation*

Ground water samples collected for dissolved metals analysis will be field filtered through a 0.45  $\mu\text{m}$  pore size filter prior to preservation to allow determination of dissolved metals. The filtering system used will be a Millipore®, OM100 Hazardous Waste Filtration System. This filtering system is constructed of all stainless steel and Teflon material. The ground water sample will be decanted into the filtering system containing a new 0.45  $\mu\text{m}$  pore sized filter. The sample is filtered under pressure using inert nitrogen gas. The sample will be filtered directly into the sample container with the necessary preservation already added.

Immediately after collection, samples will be transferred to properly labeled (see Section 5 of this QAPP) sample containers with all necessary preservatives added. Table 4-1 lists the proper container material, volume requirement, and preservation needed for the Tyler investigation. Samples requiring refrigeration for preservation will be immediately transferred to coolers packed with ice or ice packs. Proper chain-of-custody documentation will be maintained as discussed in Section 5 of this QAPP.

Field measurements for pH, specific conductance, and temperature will be obtained on ground water samples immediately following sample collection. A grab sample collected in a beaker will be used to obtain measurements. All measurement probes will be rinsed with distilled water between samples.

## SECTION 5 SAMPLE CUSTODY

The primary objective of sample custody procedures is to create an accurate written record which can be used to trace the possession and handling of all samples from the moment of their collection, through analysis, until their final disposition. Custody for samples collected during this investigation will be maintained by the Project Geologist or the field personnel collecting the samples. The Project Geologist or the field personnel will be responsible for documenting each sample transfer and maintaining custody of all samples until they are shipped to the laboratory.

ERM will use laboratory-supplied bottles appropriate for each media as sample containers. All necessary chemical preservatives will be added to the bottles prior to the sampling event, where appropriate. Custody of the sample bottles will be maintained by the Project Geologist. Sample bottles needed for a specific sampling task will be relinquished by the Project Geologist to the sampling team after the Project Geologist has verified the integrity of the bottles and ensured that the proper bottles have been assigned to the task to be conducted.

A self-adhesive sample label will be affixed to each container during sample collection. At a minimum, the sample label will contain the following information, as shown on Figure 5-1:

- Client - Job Name (Clark - Tyler Refrigeration),
- ERM Traffic Report Number,
- Sample identification - place of sampling,
- Date and time collected,
- Sampler's initials,
- Testing required, room permitting, and
- Preservatives added.

Immediately after sample collection, each sample bottle will be sealed in an individual plastic bag. Samples will then be placed immediately into an insulated cooler for shipment to the laboratory. ERM field Chain-of-Custody records (Figure 5-2) and an ERM Traffic Report (Figure 5-3) completed at the time of sample collection will accompany the samples inside the cooler for shipment to the laboratory. The samples will be properly relinquished on the field

FIGURE 5-1  
SAMPLE CONTAINER LABEL

Client/W.O.#:		Traffic Report #:	
Sample Identification:			
Collection Information:		<input type="checkbox"/> Composite <input type="checkbox"/> Grab	
Date:	Time:	By:	
Testing Required:			
Preservative:			

Environmental Resources Management, Inc.  
855 Springdale Dr. • Exton, PA 19341 • (215) 524-3500

L1-808 **The ERM Group**

Client/W.O. #		
Traffic Report/Sample I.D.		
Collection Information:		
Date:	By:	Time:
Preservatives:		

Environmental Resources Management, Inc. Exton, Pennsylvania • (215) 524-3500

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FIGURE 5-3  
ERM TRAFFIC REPORT FORM



# Traffic Report

<b>1</b> Project W.O.		<b>2</b> Sample Concentration		6425	
Project Name/Location		<input type="checkbox"/> Low Concentration <input type="checkbox"/> Medium Concentration			
		<b>3</b> Ship to:			
		<b>5</b> Sampling Personnel Contact			
<b>4</b> Sample Matrix		Sampler:			
<input type="checkbox"/> Liquid <input type="checkbox"/> Solid		Project Manager			
<input type="checkbox"/> Other		Phone No. (215) 524-3500		Attn:	
<b>6</b> Shipping Information		<b>7</b> Specify Type of Analyses, Number of Containers, Approx. Volume			
(Name of Carrier)		Analyses / Method Requested		No. of Bottles	Total Volume
(Date Shipped)					
(Airbill Number)					
<b>8</b> Sample Location					
Date:					
Time:					
<b>9</b> Sample Description		<b>10</b> Special Handling (e.g. Safety Procedures/Hazardous)			
<input type="checkbox"/> Surface Water <input type="checkbox"/> Soil					
<input type="checkbox"/> Ground Water <input type="checkbox"/> Solid					
<input type="checkbox"/> Leachate <input type="checkbox"/> Other:		Additional comments: (Specify data package, rush work, special detection limits, etc.)			
<input type="checkbox"/> Sediment					
<b>11</b> Condition of Samples Received (to be completed by Laboratory Log-in.)					
<input type="checkbox"/> Samples received intact					
<input type="checkbox"/> Samples at 4 degrees (C)				Log-In Person's Signature  	
<input type="checkbox"/> Samples not leaking					
<input type="checkbox"/> Container numbers match as specified in Item 7					
<input type="checkbox"/> Container tags match Chain of Custody					
<input type="checkbox"/> Cooler received with Custody Seals intact				<input type="checkbox"/> Samples contained within plastic bags	

Copies: White & Yellow copies accompany sample shipment to laboratory. Yellow copy retained by laboratory. White copy to be returned to ERM for files. Pink copy retained by sampler. Gold copy extra copy as needed (warehouse).

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Chain-of-Custody record by the sampling team. These record forms will be sealed in a ziploc plastic bag to protect them against moisture. Each cooler will contain sufficient ice and/or ice packs to ensure that proper temperature is maintained and will be packed in a manner to prevent damage to sample containers. The Project Geologist will then initial and attach a custody seal (Figure 5-4) to each sample cooler. All coolers will be shipped by an overnight courier according to current US DOT regulations or delivered directly to the laboratory via a courier. Prior to releasing the coolers, the Project Geologist will require the courier to sign an ERM Cooler Transfer Acknowledgment (Figure 5-5). Upon receiving the samples, the Laboratory Sample Custodian will inspect the condition of the samples, compare the information on the sample labels against the field Chain-of-Custody record and Traffic Reports, assign a laboratory control identification number, and log the control number into the computer sample inventory system.


The preparation of all sample bottles (cleaning technique, preservative added, etc.) will be documented. When samples requiring preservation by either acid or base are received at the laboratory, the pH will be measured and documented. The Laboratory Sample Custodian will then store the sample in a secure sample storage cooler maintained at 4°C and maintain custody until the sample is assigned to an analyst for analysis. Custody will be maintained until disposal of the analyzed samples.

The Laboratory Sample Custodian will note any damaged sample containers or discrepancies between the sample label and information on the field Chain-of-Custody record logging the sample and will note any discrepancies in Section 11 of the ERM Traffic Report. This information will also be communicated to the Project Geologist or field personnel at the earliest possible convenience so that proper action can be taken. The Chain-of-Custody form will be signed by both the relinquishing and receiving parties each time the sample changes hands, with the reason for transfer indicated.

An internal Chain-of-Custody form will be used by the laboratory to document sample possession from the Laboratory Sample Custodian to analysts and final disposition. The Laboratory's internal custody is discussed in Attachment 1. All Chain-of-Custody information will be supplied with the data packages for inclusion in the document control file.

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FIGURE 5-4  
ERM CUSTODY SEAL

	<b>OFFICIAL CUSTODY SEAL</b>	Name _____
		Date _____

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FIGURE 5-5  
ERM COOLER TRANSFER  
ACKNOWLEDGEMENT

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ERM COOLER TRANSFER ACKNOWLEDGEMENT						
DATE TIME	CLIENT / PROJECT CLIENT NUMBER	NUMBER OF COOLERS	ERM RELEASE (SIGNATURE)	RECEIVED BY (SIGNATURE)	DATE	
					TIME	

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## SECTION 6 CALIBRATION PROCEDURES AND FREQUENCY

### 6.1 Laboratory Calibration

Laboratory calibration and frequency is specified in the Contract Laboratory Program (CLP) Statement of Work (SOW) methods for both the TCL organics and TAL inorganics and is summarized in Attachment 1. CHESTER's Standard Operating Procedure (SOP) for the PPL volatile gas chromatography method is included in Attachment 2 and provides a description of the calibration and frequency necessary for this method.

### 6.2 Field Calibration

**In addition to the laboratory analyses conducted during the course of this investigation, field measurements of pH, specific conductance, and temperature will be taken for the ground water samples, and soil gas surveys will be performed.**

**Field equipment will be calibrated using standard solutions which have certified concentrations. These standards will be purchased from chemical supply houses. The frequency of field calibration procedures will, at a minimum, include the following:**

- The specific conductance and pH meter will be calibrated a minimum of once at the beginning of the day and documented in the calibrator's field book (see Section 8). Calibration will be checked mid-day and at the end of the day to ensure proper measurements are taken.**
- pH meters will be calibrated using specific techniques according to the manufacturer's instructions and two standard buffer solutions (either pH 4 and 7, or 7 and 10) obtained from chemical supply houses. The pH value of these buffers will be compensated for temperature according to the values supplied on the manufacturer's bottle label. The temperature (measured as below) at which the sample pH was measured will then be used to compensate for temperature on the meter. The same standard buffer solutions will be used to check the pH meter calibration.**
- Temperature measurements will be performed using a field thermometer (Thomas Scientific Company No. 9329A10, or**

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TABLE 6-1

CONDUCTIVITY TEMPERATURE CORRECTIONS  
FOR 1,000 UMHOS/CM CONDUCTIVITY STANDARD

<u>Temperature, °C</u>	<u>umhos/cm</u>
0	604
1	616
2	629
3	642
4	655
5	668
6	682
7	696
8	709
9	724
10	739
11	754
12	769
13	785
14	801
15	817
16	834
17	851
18	868
19	886
20	904
21	922
22	941
23	960
24	980
25	1,000
26	1,020
27	1,040
28	1,061
29	1,082
30	1,104
31	1,126
32	1,148
33	1,171
34	1,194
35	1,218

equivalent) and recorded to  $\pm 0.2$  degrees celcius. The thermometer will be calibrated once to a certified NBS thermometer. Temperature measurements will be taken with the field thermometer in ice water and boiling water, and compared to those measured with the certified NBS thermometer. The appropriate calibration factor for the field thermometer will be recorded and marked on the thermometer case.

- Specific conductance meters will be calibrated using a 1,000 umhos/cm potassium chloride (KCL) solution obtained from a chemical supply house. The conductivity probe cell constant will be calculated according to the formula:

$$K = \frac{E_T}{C_T}$$

Where:

K = probe cell constant (unitless)

$E_T$  = expected value of standard at temperature T ( $^{\circ}\text{C}$ )

$C_T$  = measured conductance value of standard at temperature T ( $^{\circ}\text{C}$ )

Table 6-1 provides the standard solution's conductivity value (E) if it is not at  $25^{\circ}\text{C}$ .

Using the cell constant calculated above and the following formula, field specific conductance measurements will be corrected to  $25^{\circ}\text{C}$ .

$$S = \frac{K \cdot C}{(1 + 0.02 (T - 25))}$$

Where:

S = Specific conductance at  $25^{\circ}\text{C}$  (umhos/cm)

K = calculated cell constant

C = field specific conductance (umhos/cm)

T = temperature ( $^{\circ}\text{C}$ ) of sample at which conductance was measured

- The Foxboro Century OVA 128 will be calibrated to a methane in air standard (87 ppm) weekly to ensure total volatile organic readings are accurate. If calibration problems are encountered, calibration will become more frequent as required. The methane in air standard is manufactured by Liquid Carbonic and marked with its certified concentration. The standard is run directly into the intake of the pickup probe and the gain adjustment of the OVA 128 is then used to calibrate the reading to 87 ppm. Any OVA, total volatile organic readings will be reported as "X ppm as methane."

#### *6.2.1 Frequency of Portable Gas Chromatograph Calibration*

The Photovac 10S70 will be calibrated with a working standard before use (see Section 7.1). Standards will be run at a minimum after every five samples (not including blanks). The frequency of standards may increase at the operator's discretion or if varying ambient temperatures are occurring. This frequency of calibration will account for any changes in response area or retention time shift due to ambient temperature changes.

## SECTION 7 ANALYTICAL PROCEDURES

All analytical procedures to be used are officially approved EPA procedures. The appropriate methods and required holding times to be met are given in Table 4-1.

The primary compound list will be the Target Compound List (TCL) and the Target Analyte List (TAL). The analytical methods which are to be used for the analysis of the sample media collected at the Site will be in accordance with "US EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic (and Inorganic) Analyses, OLM01.5 (and ILM01.0) revision. In addition to the TCL/TAL analyses, select ground water samples will also be analyzed for vinyl chloride. The appropriate method is indicated in Table 4-1 and is referenced from US EPA, "Test Methods for the Evaluation of Solid Wastes", SW-846, third edition.

These methods were chosen to provide comparability with other data typically collected for CERCLA investigations and to meet the project DQOs. These methods are the most appropriate to achieve all DQOs.

Attachment 1, Section 9 presents details on the TCL/TAL analytical methods. Attachment 2 includes CHESTER's SOP for the PPL volatile analyses.

Table 7-1 presents the TCL for organic compounds, the TAL metals, the PPL volatile organic compounds, and their respective CRQLs, CRDLs and QLs for the investigation. The TCL volatile and semivolatile organic fractions will also include mass spectral library searching for up to 10 additional volatile and 20 additional semivolatile, non-target (non-TCL) compounds.

**Geotechnical testing of the subsurface soils will be performed using ASTM and SW-846 methods. Method references for the geotechnical testing are presented in Table 7-2.**

### 7.1 Portable Gas Chromatograph Analytical Procedures

**This section details the procedures that will be used to analyze the gas headspace samples for vinyl chloride, trichloroethene, and 1,1-dichloroethene using a Photovac® 10S70 portable gas chromatograph (GC).**

**TABLE 7-1**  
**TYLER REFRIGERATION PIT SUPERFUND SITE RI**  
**ORGANIC COMPOUNDS AND INORGANIC CONSTITUENTS**  
**FOR ANALYSIS AND QUANTITATION LIMITS**  
**TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED**  
**QUANTITATION LIMITS (CRQL)**

Volatiles	CAS Number	<u>Quantitation Limits<sup>a</sup></u>	
		<u>Low Water</u> µg/L	<u>Low Soil/ Sediment<sup>b</sup></u> µg/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	10	10
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	10	10
8. 1,1-Dichloroethene	75-35-4	10	10
9. 1,1-Dichloroethane	75-35-3	10	10
10. 1,2-Dichloroethene (total)	540-54-0	10	10
11. Chloroform	67-66-3	10	10
12. 1, 2-Dichloroethane	107-06-2	10	10
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	10	10
15. Carbon Tetrachloride	56-23-5	10	10
16. Bromodichloromethane	75-27-4	10	10
17. 1,1,2,2-Tetrachloroethane	79-34-5	10	10
18. 1,2-Dichloropropane	78-87-5	10	10
19. cis-1,3-Dichloropropene	10061-01-5	10	10
20. Trichloroethene	79-01-6	10	10
21. Dibromochloroemthane	124-48-1	10	10
22. 1,1,2-Trichloroethane	79-00-5	10	10
23. Benzene	71-43-2	10	10
24. trans-1,3-Dichloropropene	10061-02-6	10	10
25. Bromoform	75-25-2	10	10
26. 2-Hexanone	591-78-6	10	10
27. 4-Methyl-2-Pentanone	108-10-1	10	10
28. Tetrachloroethane	127-18-4	10	10
29. Toluene	108-88-3	10	10

TABLE 7-1  
(CONTINUED)

Volatiles	CAS Number	Quantitation Limits <sup>a</sup>	
		Low Water $\mu\text{g/L}$	Low Soil/ Sediment <sup>b</sup> $\mu\text{g/Kg}$
30. Chlorobenzene	108-90-7	10	10
31. Ethyl Benzene	100-41-4	10	10
32. Styrene	100-42-5	10	10
33. Total Xylenes	100-42-5	10	10

a. Specific quantitation limits are highly matrix dependant. The quantitation limits which are listed may not always be achievable.

b. Quantitation limits for soil/sediment are based on wet weight. Individual sample quantitation limits will be different based on dry weight correction. Medium Level Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 120 times the individual Low Level Soil/Sediment CRQL.

**TABLE 7-1  
(CONTINUED)**

Semi-volatiles	CAS Number	Quantitation Limits <sup>a</sup>	
		Low Water μg/L	Low Soil/ Sediment <sup>c</sup> μg/Kg
34. Phenol	108-95-2	10	330
35. bis(2-Chloroethyl)ether	111-44-4	10	330
36. 2-Chlorophenol	95-57-8	10	330
37. 1,3-Dichlorobenzene	541-73-1	10	330
38. 1,4-Dichlorobenzene	95-50-1	10	330
39. 1,2-Dichlorobenzene	95-50-1	10	330
40. 2-Methylphenol	95-48-7	10	330
41. bis(2-Chloroisopropyl) ether	108-60-1	10	330
42. 4-Methylphenol	106-44-5	10	330
43. N-Nitroso-Di-n-propylamine	621-64-7	10	330
44. Hexachloroethane	67-72-1	10	330
45. Nitrobenzene	98-95-3	10	330
46. Isophorone	78-59-1	10	330
47. 2-Nitrophenol	88-75-5	10	330
48. 2,4-Dimethylphenol	105-67-9	10	330
49. bis(2-Chloroethoxy)methane	111-91-1	10	330
50. 2,4-Dichlorophenol	120-83-2	10	330
51. 1,2,4-Trichlorobenzene	120-82-1	10	330
52. Naphthalene	91-20-3	10	330
53. 4-Chloroaniline	106-47-8	10	330
54. Hexachlorobutadiene	87-68-3	10	330
55. 4-Chloro-3-methylphenol	59-50-7	10	330
56. 2-Methylnaphthalene	91-57-6	10	330
57. Hexachlorocyclopentadiene	77-47-4	10	330
58. 2,4,6-Trichlorophenol	88-06-2	10	330
59. 2,4,5-Trichlorophenol	95-95-4	25	800
60. 2-Chloronaphthalene	91-58-7	10	330
61. 2-Nitroaniline	88-74-4	25	800
62. Dimethyl Phthalate	131-11-3	10	330
63. Acenaphthylene	208-96-8	10	330



TABLE 7-1  
(CONTINUED)

Semi-volatiles	CAS Number	Quantitation Limits <sup>a</sup>	
		Low Water $\mu\text{g/L}$	Low Soil/ Sediment <sup>c</sup> $\mu\text{g/Kg}$
64. 3-Nitroaniline	99-09-2	25	800
65. Acenaphthene	83-32-9	10	330
66. 2, 4-Dinitrophenol	51-28-5	25	800
67. 4-Nitrophenol	100-02-7	25	800
68. Dibenzofuran	132-64-9	10	330
69. 2,4-Dinitrotoluene	121-14-2	10	330
70. 2,6-Dinitrotoluene	606-20-2	10	330
71. Diethylphthalate	84-66-2	10	330
72. 4-Chlorophenyl Phenyl ether	7005-72-3	10	330
73. Fluorene	86-73-7	10	330
74. 4-Nitroaniline	100-01-6	25	800
75. 4,6-Dinitro-2-methylphenol	534-52-1	25	800
76. N-nitrosodiphenylamine	86-30-6	10	330
77. 4-Bromophenyl Phenyl ether	101-55-3	10	330
78. Hexachlorobenzene	118-74-1	10	330
79. Pentachlorophenol	87-86-5	25	800
80. Phenanthrene	85-01-8	10	330
81. Carbazole	86-74-8	10	330
82. Anthracene	120-12-7	10	330
83. Di-n-butylphthalate	84-74-2	10	330
84. Fluoranthene	206-44-0	10	330
85. Pyrene	129-00-0	10	330
86. Butyl Benzyl Phthalate	85-68-7	10	330
87. 3,3'-Dichlorobenzidine	91-94-1	10	330
88. Benzo(a)anthracene	56-55-3	10	330
89. bis(2-ethylhexyl)phthalate	117-81-7	10	330
90. Chrysene	218-01-9	10	330
91. Di-n-octyl Phthalate	117-84-0	10	330
92. Benzo(b)fluoranthene	205-99-2	10	330
93. Benzo(k)fluoranthene	207-08-9	10	330

**TABLE 7-1  
(CONTINUED)**

Semi-volatiles	CAS Number	Quantitation Limits <sup>a</sup>	
		<u>Low Water</u> <u>µg/L</u>	<u>Low Soil/ Sediment<sup>c</sup></u> <u>µg/Kg</u>
94. Benzo(a)pyrene	50-32-8	10	330
95. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
96. Dibenzo (a,h)anthracene	53-70-3	10	330
97. Benzo(g,h,i)perylene	191-24-2	10	330

<sup>c</sup> Quantitation limits for soil/sediment are based on wet weight. Individual sample quantitation limits will be different based on dry weight correction. Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Semi-Volatile TCL Compounds are 30 times the individual Low Soil/Sediment CRQL.

**TABLE 7-1  
(CONTINUED)**

Pesticides/PCBs	CAS Number	Quantitation Limits <sup>a</sup>	
		Water μg/L	Low Soil/ Sediment μg/Kg
98. alpha-BHC	319-84-6	0.05	1.7
99. beta-BHC	319-85-7	0.05	1.7
100. delta-BHC	319-86-8	0.05	1.7
101. gamma-BHC (Lindane)	58-89-9	0.05	1.7
102. Heptachlor	76-44-8	0.05	1.7
103. Aldrin	309-00-2	0.05	1.7
104. Heptachlor Epoxide	1024-57-3	0.05	1.7
105. Endosulfan I	959-98-8	0.05	1.7
106. Dieldrin	60-57-1	0.10	3.3
107. 4,4'-DDE	72-55-9	0.10	3.3
108. Endrin	72-20-8	0.10	3.3
109. Endosulfan II	33213-65-9	0.10	3.3
110. 4,4'-DDD	72-54-8	0.10	3.3
111. Endosulfan Sulfate	1031-07-8	0.10	3.3
112. 4,4'-DDT	50-29-3	0.10	3.3
113. Endrin aldehyde	7421-93-4	0.10	3.3
114. Endrin ketone	53494-70-5	0.1	3.3
115. Methoxychlor	72-43-5	0.5	17.0
116. alpha-chlordane	5103-71-9	0.05	1.7
117. gamma-chlordane	5103-74-2	0.05	1.7
118. Toxaphene	8001-35-2	5.0	170.0
119. Aroclor-1016	12674-11-2	1.0	33.0
120. Aroclor-1221	11104-28-2	2.0	67.0
121. Aroclor-1232	11141-16-5	1.0	33.0
122. Aroclor-1242	53469-21-9	1.0	33.0
123. Aroclor-1248	12672-29-6	1.0	33.0
124. Aroclor-1254	11097-69-1	1.0	33.0
125. Aroclor-1260	11086-82-5	1.0	33.0

<sup>d</sup> Quantitation limits for soil/sediment are based on wet weight. Individual sample quantitation limits will be different based on dry weight correction. Medium Level Soil/Sediment Contract Required Quantitation Limits (CRQL) for Pesticide/PCB TCL Compounds are 30 times the individual Low Level Soil/Sediment CRQL.

**TABLE 7-1 (CONTINUED)**  
**ELEMENTS DETERMINED BY INDUCTIVELY COUPLED**  
**PLASMA EMISSION OR ATOMIC ADSORPTION**  
**SPECTROSCOPY**

Element (TAL Inorganics)	Contract Required Detection Limit Water (µg/L)	Contract Required Detection Limit Soil <sup>1</sup> (mg/Kg)
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1
Cadmium	5	1
Calcium	5000	1000
Chromium	10	2
Cobalt	50	10
Copper	25	5
Iron	100	20
Lead	5	1
Magnesium	5000	1000
Manganese	15	3
Mercury	0.2	0.1
Nickel	40	8
Potassium	5000	1000
Selenium	5	1
Sodium	5000	1000
Silver	10	2
Thallium	10	2
Vanadium	50	10
Zinc	20	4
Cyanide	10	0.5

Soil CRDL's presented are based on wet weight. Individual sample detection limits will be different based on dry weight correction.

Section: 7  
Revision No.: 1  
Date: November 1991

**TABLE 7-2**  
**METHOD REFERENCE NUMBERS FOR THE**  
**GEOTECHNICAL TESTING**

<u>Test</u>	<u>Method Number*</u>
Grain Size Distribution	ASTM D422
Organic Content	ASTM D2974.
Hydraulic Conductivity	EPA SW-846 Method 9100
Bulk Density	ASTM D854



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### **7.1.1 Standard Preparation**

Standards for calibration of the portable GC will be prepared by dilution of stock 200 mg/L (in-methanol) reference standards of vinyl chloride, trichloroethene, and 1,1- dichloroethene purchased from Supelco®, Inc. The stock reference standard will be diluted into 20 ml of organic free water contained in a 40 ml screw cap vial with a teflon septa to an appropriate level concentration working standard. This working standard will be at a concentration of 250 ppb initially and the concentrations adjusted, if necessary. Working standards will be prepared fresh every two days and they will be refrigerated when not in use.

The following formula will be used to calculate the volume of stock reference standard needed to prepare the working standard:

$$V_s \times C_s = V_w \times C_w$$

where:

$V_s$  = volume of stock reference standard ( $\mu$ l)

$C_s$  = concentration of stock reference standard (ppb)

$V_w$  = volume of working standard ( $\mu$ l)

$C_w$  = concentration of working standard (ppb)

The working standard will be used to compare retention times for qualitative identification of vinyl chloride, trichloroethene, and 1,1-dichloroethene in the samples. The response areas established by calibration standards will be used to provide quantitative analysis.

### **7.1.3 Sample Analysis**

Following instrument standardization, a Hamilton gas tight syringe will be used to obtain an aliquot from the soil gas probe. An appropriate size volume will then be injected onto the column of the portable GC for qualitative and quantitative analysis. The column used will be a ten meter CP-Sil wide bore capillary column. The carrier gas (zero-grade air) flow rate will be adjusted to 10 ml/min, with an up-slope sensitivity of 18 mV/sec and a down-slope sensitivity of 14 mV/sec. The Plotter chart speed will be on 1.0 cm/min for a total analysis time of 600 seconds. The instrument will be operated in the manual mode,

without the library identification function to allow operator override and manual interpretation of the chromatograms.

Sample chromatograms will be compared to the appropriate calibration standard chromatograms to determine whether vinyl chloride, trichloroethene, or 1,1- dichloroethene is qualitatively present based on relative retention time. Quantitation for positive identifications will be based on the response area ratios for the sample to the working standard of known concentration of the calibration standard. Section 8.1 presents the equation that will be used to calculate sample concentrations and analytical detection limits.

## SECTION 8 DATA REPORTING, VALIDATION, AND REDUCTION

Data validation practices will be followed to ensure that raw data are not altered and that an audit trail is developed for those data which required reduction. All the field data, such as those generated during field measurements, observations, and field instrument calibrations, will be entered directly into a bound field notebook. Each project team member will be responsible for proofing all data transfers made, and the Project Geologist will proof at least ten percent of all data transfers.

Analytical data for all of the samples will be validated by ERM's Quality Assurance Chemist. Data validation is discussed in detail in Section 12.

It is anticipated that ERM's data reduction for this investigation will be minimal and will consist primarily of tabulating the analytical results into summary tables through the use of computerized spreadsheet software. All reduced data will be assigned document control identification numbers and placed in the central file maintained by the Project Manager.

All analytical data obtained for ground water samples during the course of the investigation will be reported as  $\mu\text{g/L}$  (TCL/TAL and PPL parameters). Analytical data for soil/solid matrices will be reported as  $\mu\text{g/Kg}$  (TCL parameters) and  $\text{mg/Kg}$  (TAL parameters). Data packages associated with the TCL/TAL analyses of samples collected during the investigation will be prepared utilizing US EPA CLP deliverable formats. The data packages which will be provided for the PPL parameters are presented in Table 8-1.

All raw field data will be summarized, reduced, or tabulated for use in the investigation reports by the Project Geologist. All laboratory analytical data will be summarized and tabulated upon receipt. The data will be completely validated and qualified (see Section 12), and the final data submitted to the project team for use in the investigation reports.

ERM will require a rigorous data control program which will ensure that all documents for the investigations are accounted for as they are completed. Accountable documents include items such as logbooks, field data records, correspondence, chain-of-custody records,



**TABLE 8-1**  
**REQUIRED DELIVERABLES FOR 8010 ANALYSES**

- **Title Page** - present site name, field sample numbers and corresponding laboratory control numbers and the appropriate laboratory manager's signature authorizing release of the data.
- **Table of Contents** - list all major sections of the delivered document with the referenced page numbers. This can be incorporated onto the Title Page.
- **ERM Chain of Custody Forms and Traffic Report Forms** - copies of the documents signed by the laboratory sample log-in personnel.
- **Laboratory Chronicle** - supply the dates of preparation and analysis for each analysis fraction and sample.
- **Methodology Summary** - present a brief summary of the method used and the appropriate method reference.
- **Analysis Reports** - present the analyte and indicate the values for positive hits and the quantitation limit for analytes which were not detected. Report an individual analysis report for each sample.
- **Quality Control Summary** - present summary forms of surrogate compound recoveries and RPDs, matrix spike/matrix spike duplicate recoveries, method blank, and internal standard analysis results. Instrument calibration (initial and continuing) data must also be tabulated on summary forms.

**GC Analysis Data**

- **Raw Sample Data** - provide GC chromatograms and instrument quantitation reports which include library list of compounds, peak retention times, peak areas, peak heights and raw concentration data.

**TABLE 8-1  
(CONTINUED)**

- **Standards Data Package**
  - **Initial Calibration** - provide GC chromatograms and instrument quantitation reports which include library list of compounds, peak retention times, peak areas, peak heights and raw concentration data for each level standard associated with the initial calibration. Provide response factors for each standard.
  - **Continuing Calibration** - provide GC chromatograms and instrument quantitation reports which include library list of compounds, peak retention times, peak areas, peak heights and raw concentration data for all check standards. Provide response factors and indicate if acceptance criteria was met for the continuing calibration.
- **Raw Quality Control Data** - provide GC chromatograms and instrument quantitation reports which include library list of compounds, peak retention times, peak areas, peak heights and raw concentration data for each method blank and the matrix spike and matrix spike duplicate.

analytical reports, data packages, photographs, computer disks, and reports. The Project Manager is responsible for maintaining a central file in which all accountable documents will be inventoried.

To maintain control in the transfer of data, all copies of raw data from the field notebooks, and the data as received from the laboratory, will be entered into a data file and assigned an appropriate document control identification number. The data file will serve as the ultimate archive for all information and data generated during this investigation.

The documentation of sample collection will include the use of bound field logbooks in which all information on sample collection and field instrument calibration will be entered in indelible ink. Appropriate information will be entered to reconstruct the sampling event, including site name (top of each page), sample identification, brief description of sample, date and time of collection, sampling methodology, field measurements and observations, and sampler's initials (bottom of each page, and dated). ERM's Sampling Notebook SOP may be photocopied and attached to the front cover of the field books issued. This is presented as Figure 8-1.

### 8.1 Photovac® Data Processing

Soil gas sample results for vinyl chloride, trichloroethene, and 1,1-dichloroethene will be calculated according to the following formula:

$$C_u = \frac{A_u \times V_s \times C_s}{A_s \times V_u}$$

where:

$C_u$  = Concentration of the compound in the sample (ppb)

$A_u$  = Response area of unknown in the sample (mV/sec)

$V_s$  = Injection volume of the compound in the standard (μl)

$C_s$  = Concentration of the compound in the standard (ppb)

$A_s$  = Average response area of the compound in the standard (mV/sec)

$V_u$  = Injection volume of sample (μl)



Response areas for all standards run in a given day will be averaged for each compound and the average responses will be used for quantitation. All concentrations for positive identifications will be reported in ppb. A data summary table will be prepared from the reduced data indicating the concentrations for each sample. Detection limits will be calculated for each sample based on the minimum response area determined to be significant above background noise (2-1/2 times) and injection volume using the above equation.

**Figure 8-1**  
**SAMPLING LOGBOOK SOP**

One or more bound books will be maintained for each site; the book (s) will remain with the site evidence file. Copies should be made for the person who made the entries and the PM if requested.

All entries in the Logbook must be made in ink.

First Page should contain:

- Site name and number
- Date and time started
- Personnel on site

Next page(s) DTW for all wells if required by the sampling plan. S/N of the DTW meter.

Each new day should contain:

- Date and time started
- Weather
- Personnel on site - including any non-ERM personnel
- Sampling information (see next page)

- \* When a mistake is made in the Log, put a single line through it in ink and initial and date.

**Figure 8-1 (Continued)**

**SAMPLE INFORMATION**

- Sample # (Traffic Report)
- Date and Time Sample collected
- Source of Sample (well, stream, domestic well, field, etc.)
- Purged Well - type of equipment, purge volume, rate of purge, and decon procedures
- Location of Sample - document with a site sketch and/or written description, where sample was taken so that it could be found again
- How was sample taken? (bailer, trowel SS spoon, thief, etc.)
- Analysis and QA/QC required
- Chemical Preservation used (HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, NaOH, etc.)
- Field Data (pH, DO, spec. and temp., etc.)
- Field Observations - significant observation should be documented.
  - Sample condition (color, odor, turbidity, oil, sheen)
  - Site condition (stressed vegetation, exposure of buried wastes, erosion problems, etc.).
- How sample was shipped, date, time and where to, and if legal seals were attached to transport container(s).
- Comments - Any observation or event that occurred that would be relevant to the site; for example, weather changes or effect it had on sampling, conversations with the client, public official or private citizen; instrument calibration, equipment problems, etc.

## SECTION 9 INTERNAL QUALITY CONTROL CHECKS

### 9.1 Laboratory Internal Quality Control Checks

The CHESTER's Internal Quality Control Checks are presented in Attachment 1. These will be a continuation of ERM's Field Internal Quality Control Checks presented below.

### 9.2 Field Internal Quality Control Checks

Field Internal Quality Control Checks will be utilized during this investigation through the use of the following:

- Trip Blanks - These blanks consist of ultrapure, deionized water contained in each sample container with any preservatives required for that analysis. ERM produces ultrapure deionized water by use of a Hydros® Deionized Water System. These blanks will accompany the samplers during the sampling process and will serve as QC checks on container cleanliness, external contamination, and the analytical method. Trip blanks will be submitted blind using a fictitious sample location for volatile organic analyses once only per cooler for the ground water, surface soil, and soil boring samples.
- Equipment Rinsate (Field) Blank - Equipment rinsate (Field) blanks will be collected to ensure that sampling equipment is clean and that the potential for cross contamination has been minimized by the equipment decontamination procedures. These blanks will be collected by decontaminating the sampling device and then pouring ultrapure deionized water (from the Hydros® system) or distilled water over the device. This rinsate water will be collected into a clean stainless steel bowl, if necessary, and then transferred to the appropriate sample containers or directly into the sample container. **Equipment rinsate blanks will be collected for each sampling device associated with the ground water and soil sampling at a frequency of one per twenty samples or one per sampling event, whichever is more frequent. The equipment rinsate blanks will be analyzed for identical parameters as the samples.**



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- Duplicate Samples - Blind duplicate samples will be collected to allow determination of analytical and sampling precision. One duplicate sample in every twenty (20) ground water and soil samples will be collected and submitted for the identical parameters as the true sample.
- Matrix Spike Sample - Matrix spike/matrix spike duplicates (MS/MSD) samples will also be submitted as further QC checks. These samples will be spiked at the laboratory. These will be collected at the frequency of one MS and MSD for every twenty (20) field samples (including trip blanks, field blanks, and blind duplicates). These will allow accuracy to be determined by the recovery rates of compounds (the matrix spike and/or surrogate spike compounds defined in the analytical methods). Precision will also be assessed by comparison of matrix spike duplicate recoveries. The purpose of these laboratory spikes is to monitor any possible matrix effects specific to samples collected from the Tyler site. The addition of known concentrations of compounds/constituents into the sample also monitors extraction/digestion efficiency.

Matrix spike/matrix spike duplicate sample aliquots will be acquired for ground water analyses by providing triple the necessary sample volume for the location identified for these QC samples. Matrix spike/matrix spike duplicate sample aliquots for solid/soil analyses will be split from the designated sample location at the laboratory. The laboratory will select aliquots that are as homogeneous with respect to one another as possible to avoid precision problems related to sample in-homogeneity. Homogenizing is discouraged prior to splitting duplicates to avoid loss of volatile organic compounds. The specific sample location which will be used for matrix spikes and blind duplicates will be chosen by the Project Geologist with direction from the Quality Assurance Coordinator.



## SECTION 10 PERFORMANCE AND SYSTEM AUDITS

### 10.1 On-Site Audit

An on-site system audit will be performed during the initial sampling event to review all field-related quality assurance activities. The system audit will be conducted by the **QA Coordinator or Field Services Manager**. Figure 10-1 presents ERM's Quality Assurance Audit forms. The acceptance criteria for the field audit will be adherence to the protocols presented throughout the QAPP. Deficiencies found during the audits will be brought to the attention of the responsible individuals and corrective action as per Section 13 of this QAPP will be initiated.

Specific elements of the on-site audit will include the verification of the following:

- Completeness and accuracy of sample Chain-of-Custody forms, including documentation of times, dates, transaction descriptions, and signatures.
- Completeness and accuracy of sample identification labels, including notation of time, date, location, type of sample, person collecting sample, preservation method used, and type of testing required.
- Completeness and accuracy of field notebooks, including documentation of times, dates, drillers' names, sampling method used, sampling locations, number of samples taken, name of person collecting samples, types of samples, results of field measurements, soil logs, and any problems encountered during sampling.
- Adherence to health and safety guidelines outlined in the Site Health and Safety Plan, including wearing of proper protective clothing.
- Adherence to decontamination procedures outlined in Section 4 of this QAPP, including proper documentation of pumps and pump tubing, bailers, and sampling equipment.
- Adherence to sample collection, preparation, preservation, and storage procedures.



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## **10.2 Laboratory Audit**

### **10.2.1 Internal Laboratory Audits**

CHESTER performs regular systems and performance audits, and these are described in **Attachment 1, Section 5.8.5.**

### **10.2.2 ERM's Performance Audit of CHESTER**

**CHESTER currently holds an inorganic contract in EPA's Contract Laboratory Program (CLP). Additionally, they have previously held an organic CLP contract. At this date, CHESTER has successfully analyzed a pre-award performance evaluation sample according to the OLM01.0 protocols, and has successfully passed a pre-award on-site audit by EPA. It is anticipated that CHESTER will be a participant in the CLP for both organic and inorganic fractions at the time of project start-up.**

**The most recent CLP Performance Evaluation samples analyzed during the investigation will be requested and reviewed to evaluate laboratory accuracy. Acceptance criteria for the performance audit of CHESTER will be successfully passing the analysis of the CLP Performance Evaluation sample.**

### **10.3 Audit Results**

Results of the evaluation of both the field and laboratory audits will be submitted to ERM's Project Manager for review. If the results of the audit necessitate further action, the Project Manager and the Technical Committee will be notified of such and will be apprised of any corrective action taken.

**FIGURE 10-1**  
**ERM QUALITY ASSURANCE AUDIT**

Project: \_\_\_\_\_ WO Number: \_\_\_\_\_

Date: \_\_\_\_\_

Auditor(s): \_\_\_\_\_

On-Site Sampling Personnel: \_\_\_\_\_

Audit Conducted on the following:

\_\_\_\_\_ Soil Sampling \_\_\_\_\_ Decontamination

\_\_\_\_\_ Surface Water/Sediment

\_\_\_\_\_ Ground Water

Y = Yes      N = No      N/A = Not Applicable      N/D = Not Determined

**Sample Collection:**

Do sampling locations agree with those specified in the Work Plan/Sampling Plan? \_\_\_\_\_

Is the sampling location either documented sufficiently and marked to allow it to be found/sampled again in the future? \_\_\_\_\_

Are sampling times, ERM Traffic Report Numbers and sample description noted in the FNB? \_\_\_\_\_

Is sampling proceeding from the suspected least contaminated area to the most contaminated area? \_\_\_\_\_

Have all field measurements been properly taken as per Sampling Plan? \_\_\_\_\_

Are field measurement(s) being taken immediately after the sample is collected? \_\_\_\_\_

Have sample bottles been labeled properly? \_\_\_\_\_

Have proper containers and preservatives been used? \_\_\_\_\_

Are proper sample volumes procured? \_\_\_\_\_

Does the potential for sample cross-contamination exist based on procedures observed? \_\_\_\_\_

Have MS and MSD(s) been collected as per QA/QC Plan? \_\_\_\_\_

Does a travel blank exist for each matrix present? \_\_\_\_\_

Are samples being refrigerated/iced immediately after collection? \_\_\_\_\_

Has condition of sample been recorded in the FNB and in the traffic report? \_\_\_\_\_

Have legal seal(s) been properly filled out and attached to the shipping container(s)? \_\_\_\_\_

**Soil Sampling (Check if not applicable \_\_\_\_\_):**

Type: \_\_\_\_\_ Hand: \_\_\_\_\_ Auger or Rig - Backhoe Pit

Are samples being collected at proper depths? \_\_\_\_\_

Are samples being screened with an OVA (if specified in Work Plan and applicable)? \_\_\_\_\_

Is a description of soils/materials being logged? \_\_\_\_\_

Have soils been homogenized where applicable? (specified by the Sampling Plan) \_\_\_\_\_

**Surface Water/Sediment Sampling (check if not applicable \_\_\_\_\_):**

Have stream flow and velocity parameters been noted? \_\_\_\_\_  
Estimated \_\_\_\_\_ or Measured \_\_\_\_\_

Has sampling proceeded from downstream to upstream locations? \_\_\_\_\_

Has the sampler acquired the water sample upstream of his position to minimize suspended sediment from entering the sample? \_\_\_\_\_

Have water samples been collected in the mixing zone, not stagnant areas? \_\_\_\_\_

Have sediments been characterized as to type and size distribution? \_\_\_\_\_

Has the proper sediment fraction (fine, depth) been sampled for the analyses of interest? \_\_\_\_\_

**Ground Water Sampling (Check if not applicable \_\_\_\_\_):**

Have organic vapor readings been obtained when the well head was opened? \_\_\_\_\_

Have depth to water level readings been taken for all wells? \_\_\_\_\_

Have the well specifications been noted properly (i.e., total depth, casing diameter, depth-to-water to the nearest one-hundredth of a foot, etc.)? \_\_\_\_\_

Has the purge volume been calculated properly? \_\_\_\_\_

Has well yield been properly evaluated to determine when sample acquisition should take place (i.e., does well go dry and need to recover)? \_\_\_\_\_

Has the purge pump been placed at the proper level to ensure proper well evacuation? \_\_\_\_\_

What evacuation method has been used?

_____ Bailer	_____ Submersible
_____ Other ( _____ )	_____ Bladder pump
_____ Centrifugal pump	_____ Foltz pump

If metals are being analyzed, have the samples been field filtered? \_\_\_\_\_

Are field pH, conductivity, and temperature being measured and documented? \_\_\_\_\_ Is there documentation of calibrating the instruments? \_\_\_\_\_

Are bailer bags marked as to site name, well ID and date of dedication? \_\_\_\_\_

Is bailer line and bailer dedicated to each well and line disposed of after use? \_\_\_\_\_

Bailer Type \_\_\_\_\_ Line Type \_\_\_\_\_

Have appropriate measures been taken to dispose of contaminated purge water, pump lines, bailers, etc.? \_\_\_\_\_

For Domestic Wells -- Has as much information on the well and distribution system been obtained (i.e., depth, casing type, diameter, treatment present, etc.)? \_\_\_\_\_

Has the sample been collected prior to treatment and as close to the well head as possible? \_\_\_\_\_

Has the domestic well been purged sufficiently to reach pH, conductivity, and temperature stabilization? \_\_\_\_\_

Have any fixtures been removed from the domestic well before the sample was taken? \_\_\_\_\_

**Decontamination:**

Has sampling equipment been decontaminated properly for the given analytes as per QA Plan? \_\_\_\_\_

Have the proper decontamination solutions been used? \_\_\_\_\_

For large equipment (backhoes, drill rigs), has decontamination taken place in an appropriate area? \_\_\_\_\_

Has decontamination water/solution been collected for proper disposal? \_\_\_\_\_ Where disposed? \_\_\_\_\_

Has disposable equipment, that is contaminated, been properly deconned and disposed of? \_\_\_\_\_

Have decon samples been taken from the sampling equipment as per Sampling Plan? \_\_\_\_\_

**General:**

Has all appropriate information been recorded in the FNB? \_\_\_\_\_

Have the weather conditions been recorded? \_\_\_\_\_

Are weather conditions affecting sample quality? \_\_\_\_\_

Is the "Chain of Custody" being maintained for the samples? \_\_\_\_\_

Have all personnel been properly trained to operate the equipment present? \_\_\_\_\_

Are the objectives of the sampling activities understood by the field personnel? \_\_\_\_\_

Are employees conducting the investigation in a professional manner? \_\_\_\_\_

**Audit Summary and Comments**

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Section: 10  
Revision No.: 0  
Date: 15 July 1991

Signed by:

**Sampler:** \_\_\_\_\_ **Print Name:** \_\_\_\_\_

**Auditor:** \_\_\_\_\_

Date: \_\_\_\_\_

## **SECTION 11 PREVENTIVE MAINTENANCE**

### **11.1 Laboratory Maintenance**

CHESTER's laboratory preventive maintenance programs and requirements are described in Attachment 1.

### **11.2 Field Maintenance**

ERM's field equipment is maintained through the use of a tracking system incorporating the tagging of each equipment item. This tag identifies its most recent maintenance, battery charge, and condition. When damaged or equipment in need of repair is returned to the equipment warehouse, it is appropriately flagged for the required maintenance to be performed. This process ensures that only operable and maintained equipment enters the field. Routine daily maintenance procedures conducted in the field will include the following:

- Removal of surface dirt and debris from exposed surfaces of the sampling equipment and measurement systems.
- Cleansing of filters on the organic vapor analyzer.
- Storage of equipment away from the elements.
- Daily inspections of sampling equipment and measurement systems for possible problems (e.g., cracked or clogged lines or tubing or weak batteries).
- Check instrument calibrations as described in Section 6.2 of this QAPP.
- Charging any battery packs for equipment when not in use.

Spare and replacement parts stored in the field to minimize downtime include the following:

- Appropriately sized batteries
- Locks
- Extra sample containers and preservatives
- OVA igniters and filters



- OVA H<sub>2</sub> gas, battery charger, and support equipment
- Extra samples coolers, packing material, and sample location stakes.
- Additional supply of health and safety equipment, i.e., respirator cartridges, boots, gloves, tyvek, etc.
- Additional equipment as necessary for the field tasks.

## **SECTION 12**

### **SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS**

#### **12.1 Overall Project Assessment**

Overall data quality will be assessed by a thorough understanding of the data quality objectives which are stated during the design phase of the investigation. ERM will closely monitor data accuracy, precision, and completeness by maintaining thorough documentation of all decisions made during each phase of sampling, performing field and laboratory audits, thoroughly reviewing (validating) the analytical data as it is generated by the laboratory, and providing appropriate feedback as problems arise in the field or at the laboratory.

#### **12.2 Field Quality Assessment**

To ensure that all field data are collected accurately and correctly, specific written instructions will be issued to all personnel involved in field data acquisition by the Project Geologist. The Project Geologist will perform field audits during the initial sampling events of the investigation to document that the appropriate procedures are being followed for sample (and blank) collection. These audits will include a thorough review of the field books used by the project personnel to ensure that all tasks were performed as specified in the instructions. The field audits will necessarily enable the data quality to be assessed with regard to the field operations.

The evaluation (data review) of trip and field blanks and other field QC samples will provide definitive indications of the data quality. If a problem arises which can be isolated, corrective actions can be instituted for future field efforts.

#### **12.3 Laboratory Data Quality Assessment**

Laboratory personnel are responsible for assuring the quality of the analytical data generated. The laboratory analyst evaluates the data at the bench or instrument, making sure that specific quality control acceptance criteria are met. All data will be reviewed by the laboratory group leader prior to data deliverable generation to check for transcription errors and to ensure that specific quality control acceptance criteria are met and that corrective actions have been

**Table 12-1**  
**ITEMS REVIEWED DURING THE ERM DATA VALIDATION**

<u>Area Examined</u>	<u>Applicability</u> (organic, inorganic, both)
ERM and Laboratory Chain of Custodies (Traffic Reports, Field Notes, etc.)	Both
Holding Times	Both
Extraction/Digestion Logs	Both
Blanks - field and laboratory (accuracy)	Both
Instrument Tune	Organic
Standards	Both
Linearity	Both
Sensitivity/Stability	Both
Selectivity/Specificity	Both
Variability of Technique (internal standards)	Organic
Analyte Breakdown	Both
Analytical Sequence	Both
ICP Interference	Inorganic
Control Standards	Both
Samples	
Detection Limits	Both
Instrument Printouts	Both
ICP data	Inorganic
AA data	Inorganic
GC data	Organic
GG/MS data	Organic
Autoanalyzer data	Inorganic
Qualitative Identification	Both
Mass spectra	
Pesticide/PCB chromatograms	
Quantitative Reliability	Both
Calculations/Equations	Both
Matrix spikes (accuracy)	Both
Bias	

**Table 12-1**  
**ITEMS REVIEWED DURING THE ERM DATA VALIDATION**

<u>Area Examined</u>	<u>Applicability</u> (organic, inorganic, both)
Matrix spikes duplicated	Organic
Bias	
Accuracy & Precision	
Surrogate Spikes	Organic
Bias	
Duplicated (field and laboratory)	Both
Precision	
Representativeness	
Post-Digestion Spikes	Inorganic
Matrix Effects	

taken when necessary. All data deliverables will be reviewed by both the quality assurance manager and the laboratory manager prior to the release to the client.

## 12.4 ERM's Laboratory Data Quality Assessment

### 12.4.1 ERM Data Validation

The analytical data generated during the investigation will undergo a rigorous data validation review. This review will be performed in general accordance with the "Laboratory Data Validation Functional Guidelines for the Evaluation of Organic (and Inorganic) Analysis" (US EPA Data Review Work Group, 2/88 for Organics and 7/88 for Inorganics), **and the Region III modifications to "Laboratory Data Validation Functional Guidelines for the Evaluation of Organic (and Inorganic) Analysis"**.

A preliminary review will be performed to verify that all necessary paperwork (chain-of-custodies, analytical reports, laboratory personnel signatures) and deliverables as stated in the US EPA CLP requirements were provided by the laboratory. CLP-equivalent deliverables will be provided by the laboratory for the gas chromatography parameters.

A detailed quality assurance review of the analytical data will be performed by the ERM Quality Assurance Chemist to verify the qualitative and quantitative reliability of the data as it is presented. This review will include a detailed review and interpretation of all data generated by CHESTER. The primary tools which will be used by experienced data review chemists will be guidance documents, established (contractual) criteria, and professional judgement. Table 12-1 presents the items that will be examined during the comprehensive quality assurance review for of the data. Table 12-2 presents the validation criteria to be used to evaluate data generated for 8010 analyses.

Based upon the review of the analytical data, an organic and inorganic quality assurance report will be prepared which will state in a technical, yet "user friendly," fashion the qualitative and quantitative reliability of the analytical data. The report will consist of a general introduction section, followed by qualifying statement that should be taken into consideration for the analytical results to best be utilized. Based upon the quality assurance review, qualifier codes will be placed next to specific sample results on the sample data table. These *qualifier codes will serve as an indication of the qualitative and quantitative reliability.*

*During the course of the data review, an organic and inorganic support documentation package will be prepared which will provide the*



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backup information that will accompany all qualifying statements presented in the quality assurance review.

Once the review has been completed, the Quality Assurance Coordinator will verify the accuracy of the review and will then submit these data to the Project Manager. These approved data tables and quality assurance reviews will be signed and dated by the Quality Assurance Coordinator.

#### **12.5 Data Management Quality Assessment**

As the analytical data generated from the subject investigation are validated, qualified, and submitted to the Project Manager, the quality of the data will be assessed from an overall management perspective by direct comparison of analytical results obtained from previous samplings. Information that can be obtained will include a comparison of results obtained from samples taken within the same general vicinity, and the identification of missing data points. By examination of the data at the "back-end" of the process, the data quality can be assessed with respect to representativeness, precision, compatibility, and completeness.

## **SECTION 13 CORRECTIVE ACTION**

### **13.1 CHESTER Corrective Action**

Correction actions for CHESTER are presented in Attachment 1. CHESTER will provide documentation as to what, of any, corrective actions were initiated concerning this study and report them to ERM's Quality Assurance Coordinator.

### **13.2 ERM's Corrective Action**

Field quality assurance activities will be reported topically to ERM's Project Manager. Problems affecting quality assurance that are encountered during the study will be reported on a Corrective Action Form as presented in Figure 13-1. The Project Manager will report to the Quality Assurance Coordinator on all necessary corrective actions taken, the outcome of these actions, and their effect on data produced.

## SECTION 14 QUALITY ASSURANCE REPORT TO MANAGEMENT

The Project Manager in conjunction with the Quality Assurance Coordinator, will submit a progress report summary, if appropriate, of applicable quality assurance activities. This summary may be attached to the monthly progress report, if appropriate, and may contain but not to be limited to the following types of information:

- The status and coverage of various laboratory and field quality assurance project activities;
- Data quality assurance reviews including assessment of accuracy, precision, completeness, representativeness, and comparability;
- Significant quality assurance problems discovered, corrective actions taken, progress and improvements, plans, and recommendations for further implementation of updating of the investigative QAPP;
- Any significant field observations noted in the field notebook during the sampling procedure; and
- Results of performance and system audit reports.



**ATTACHMENT 1  
CHESTER LabNet  
QUALITY ASSURANCE PLAN**



AR300551

STANDARD OPERATING PROCEDURE  
6211.02

Revision 0  
3/22/91

ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN WATER AND  
WASTEWATER BY PURGE-AND-TRAP GC/HALL DETECTOR  
METHOD (EPA METHOD 8010)

APPROVALS:

QA/QC Manager \_\_\_\_\_ Date \_\_\_\_\_  
Laboratory Manager \_\_\_\_\_ Date \_\_\_\_\_  
Technical Director \_\_\_\_\_ Date \_\_\_\_\_

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## **1.0 SCOPE AND APPLICABILITY**

The purpose of this Standard Operating Procedure is to describe the procedures in place at Chester LabNet Laboratories for the analysis of volatile organics by gas chromatography/Hall Detector. The method is adapted from the following source:

Method 8010, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA Publication SW-846, Revision 1, December 1987

This SOP is designed to address only the specific requirements and basic instrument set-up, calibration and run scheme as they relate to the protocol cited above. The individual instrument operations are outlined under a separate SOP.

The Target Compound List (TCL) for which this method is suitable and their respective quantitation limits are specified on Table 1. Other analytes may be analyzable by this method; however, they are not currently on the Target Compound List. Furthermore, recovery data must be determined for them before they may be included in the analytical scheme.

Analyses of the samples must be completed within 14 days of sample collection.

## **2.0 SUMMARY OF METHOD**

An inert gas is bubbled through an aliquot of the aqueous sample. This purging of the water samples is performed at ambient temperature. The volatiles are swept from the purging chamber and collected on a solid sorbent column. The solid sorbent is then thermally ramped rapidly to release the volatiles into a gas chromatograph. The GC is temperature programmed to separate the volatiles, which are then detected with the Hall electrolytic conductivity detector.

The identification of the target analytes is performed through their GC retention times and confirmed by their retention times on a secondary column. Quantitation is performed by measuring the peak areas within the proper retention time window.

## **3.0 SAFETY MEASURES**

During the handling of standards and the extracts, the analyst must prevent breathing or contact with the materials. The analyst shall:

- a. Wear safety glasses at all times
- b. Wear protective gloves
- c. Open and handle the extracts and standards in a ventilation hood

All volatile samples are susceptible to contamination. In order to minimize the potential for such contamination, samples will be stored in a separate refrigerator designated strictly for volatile samples storage. There will be no solvent storage or standards storage with the samples.

Table 1

Target Compound List and  
Quantitation Limits for Volatile Organics

Volatile Organic Compound	CAS Number	Quantitation Limits
		Water, ug/L
Bromodichloromethane	75-27-4	1.4
Bromoform	75-25-2	20
Bromomethane	74-83-9	20
Carbon Tetrachloride	56-23-5	1.2
Chlorobenzene	108-90-7	3.7
Chloroethane	75-00-3	5.9
Chloroform	67-66-3	1.0
2-Chloroethyl vinyl ether	100-75-8	20
Chloromethane	74-87-3	20
Dibromochloromethane	124-48-1	3.9
1,1-Dichloroethane	75-34-3	1.1
1,2-Dichloroethane	107-06-2	1.6
1,1-Dichloroethene	75-35-4	1.8
trans-1,2-Dichloroethene	156-60-5	1.6
1,2-Dichloropropane	78-87-5	1.7
cis-1,3-Dichloropropene	10061-01-5	3.0
trans-1,3-Dichloropropene	10061-02-6	3.9
Dichloromethane	75-09-2	1.4
1,1,2,2-Tetrachloroethane	79-34-5	5.0
Tetrachloroethene	127-18-4	5.0
1,1,1-Trichloroethane	71-55-6	1.3
1,1,2-Trichloroethane	79-00-5	3.9
Trichloroethene	79-01-6	1.4
Trichlorofluoromethane	75-69-4	1.4
Vinyl Chloride	75-01-4	20

## 4.0 SUPPORTING MATERIALS AND EQUIPMENT

4.1 Apparatus and Materials

## 4.1.1 GC

4.1.1.1 GC capable of being temperature programmed and with flow controls capable of maintaining constant flow rates throughout the desorption process and the analytical program. The GC must be capable of being interfaced to the purge-and-trap system

4.1.1.2 GC columns, either packed or capillary

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4.1.1.2.1 Primary packed column - 2.4 m. long X 2 mm. ID glass column, packed with 1% SP-1000 on Carbopak B (60/80 mesh), or equivalent

4.1.1.2.2 Secondary packed column - 1.8 m. long X 2 mm. ID glass column, packed with chemically bonded n-octane on Porasil-C (100/120 mesh), or equivalent

4.1.1.3 Detector - Hall electrolytic conductivity.

4.1.1.4 Data system that allows for data acquisition and storage throughout the chromatographic run; at a minimum capable of storing retention times and integrated peak areas.

4.1.2 Purge and trap device, capable of operating the purging chamber at room temperature, and designed to accept 5 mL water samples with a column depth of at least 3 cm.

The trap must be at least 25 cm long, and have an inside diameter of at least 0.105 in. The trap is packed with 15 cm. of Tenax-GC, 60/80 mesh, and 8 cm of silica gel, grade 15, 35/60 mesh.

The desorber must be capable of heating the trap rapidly to 180°C.

4.1.4 Syringes - 10 uL and 25 uL volumes

4.1.5 Gas tight syringe - 5 mL with valve

4.1.6 Miscellaneous volumetric flasks, class A

4.1.7 Standard laboratory glassware

## 4.2 Reagents and Standards

4.2.1 Solvent - Methanol, pesticide quality or equivalent

4.2.2 Reagent water - Millipore ultra-pure water free from volatile organics at their detection limits

4.2.3 Stock standard solutions - Stock standard solutions of the target compounds are purchased as four different mixtures. The compounds present in each mixture are each at a concentration of 200 ug/mL in methanol

4.2.4 Matrix Spike Stock Solution - This solution is also purchased, with each component in the solution at a concentration of 20 mg/mL in methanol. The solution contains

Bromochloromethane  
1,4-Dichlorobutane  
2-Bromo-1-chloropropane

#### 4.2.5 Secondary standard solutions

##### 4.2.5.1 Secondary Standard I

4.2.5.1.1 Remove the stock TCL standards mixtures from the freezer and allow them to reach room temperature before using them.

4.2.5.1.2 With a 500 uL syringe, remove 250 uL from each of the four stock standards and transfer into a 1 mL volumetric flask. Stopper the flask and mix by inverting three times. The resulting solution contains 50 ug/mL of each of the standard compounds.

##### 4.2.5.2 Secondary Standard II

4.2.5.2.1 Into another 1 mL volumetric flask, transfer 200 uL of Secondary Standard I and dilute to the mark with room temperature methanol. The resulting solution contains 10 ug/mL of each of the standard compounds.

#### 4.2.6 Calibration Standards

Take five 10-mL volumetric flasks and place in each 9.8 mL laboratory reagent water. Proceed to add either Secondary Standard I or Secondary Standard II as shown in the Table below

	Vol. Secondary Standard I, uL	Vol. Secondary Standard II, uL	Total Vol. mL	Conc.* ug/L
Dil. 1	0.0	5.0	10	5
Dil. 2	0.0	20.0	10	20
Dil. 3	10.0	0.0	10	50
Dil. 4	20.0	0.0	10	100
Dil. 5	40.0	0.0	10	200

\*) The stated concentration is the concentration of each component in the mixture.

#### 4.2.7 Secondary dilution of matrix spike solution

To a 10 mL volumetric flask, add 9.8 mL methanol. Using a syringe transfer 75 uL of the matrix spike stock solution into the flask. Dilute to the mark with methanol and mix by inverting three times. The resulting solution contains 150 ug/mL of each of the components.

#### 4.2.8 Working matrix spike solution

To a 10 mL volumetric flask, add 8.5 mL laboratory reagent water. Using a syringe, transfer to the flask 1 mL of the secondary matrix spike solution. Dilute to the mark with water. Mix by inverting the flask three times. The resulting solution contains 15 ug/mL of the matrix spike solution.

The addition of 10  $\mu$ L of this solution to every 5 mL aliquot of sample, standard or blank will result in a concentration of 30  $\mu$ g/L of the matrix spiking compounds.

4.2.9 Continuing Calibration Check (CCC) Solution - The CCC is equivalent to Dil. 3 in step 4.2.6. It is run at least once every 12 hours.

4.2.10 The calibration solutions can be stored for 24 hours, if they are protected from light, maintained with zero headspace, and stored at 4°C.

## 5.0 GC SET-UP AND INITIAL CALIBRATION

### 5.1 GC Set-up

5.1.1 Set the purge and trap device for the following conditions:

Purge gas	Helium
Purge time	11.0 $\pm$ 0.1 min.
Purge flow rate	25-40 mL/min. (adjustable)
Purge temperature	Ambient
Desorb temperature	180°C
Desorb flow rate	15 mL/min.
Desorb time	4.0 $\pm$ 0.1 min.
Reconditioning temperature	180°C
Reconditioning time	7.0 $\pm$ 0.1 min.

For a new trap, condition the trap overnight at 180°C at a flow rate of 20 mL/min, venting the trap effluent into the hood, not into the analytical system. On a daily basis, condition the trap for 10 minutes at 180°C, venting the effluent into the hood.

5.1.2 Set the GC conditions to the following:

Carrier gas	Helium
Flow rate	
Packed column	30 mL/min
Initial temperature	
Packed column	40°C
Initial hold time	
Packed column	4 min.
Ramp	
Packed column	10°C/min.
Final Temperature	
Packed column	220°C
Final hold time	
Packed column	15 min.

Optimize the GC conditions for maximum analyte separation and sensitivity. Once optimized, the conditions should remain the same for the analysis of all standards and samples.

- 5.1.3 Set the Hall detector to the following conditions:

Base Temperature	250°C
Reactor Temperature	815°C

## 5.2 GC Initial Calibration

- 5.2.1 Prepare a method blank (MB) by adding 10 uL of the working matrix spike solution (4.2.8) into 5.0 mL sample of laboratory reagent water.
- 5.2.2 If the purge and trap system is automatic, charge each purge tube with 5.0 mL of calibration standard, and add to each 10 uL of the working matrix spike solution. Arrange the purge tubes so that the run sequence will be as follows:

Run No.	Solution
1	Method Blank
2	Dil. 1
3	Dil. 2
4	Dil. 3
5	Dil. 4
6	Dil. 5
7	MB

If the system is not automatic, set the same sequence as above one at a time. Set the GC program and data acquisition program to start at the end of the purge sequence. Set the purge program to meet the conditions specified in Section 5.1.1, after these conditions have been optimized.

- 5.2.3 Verify manually that each peak is correctly identified by the data system.
- 5.2.4 For each target analyte and matrix spike compound, calculate the response factor in each of the standards

$$RF = \frac{A_x}{C_x}$$

where,

RF = Response factor

A<sub>x</sub> = Area of the target analyte peak

C<sub>x</sub> = Concentration of the target analyte, in ug/L

- 5.2.5 Calculate the mean RF for each compound from the equation

$$RF_{xm} = \frac{\sum_{i=1}^n RF_{xi}}{n}$$



where,

$RF_{xm}$  = The mean RF for compound "x"

$RF_{xi}$  = The calculated RF for compound "x" at the concentration "i"

n = The number of determinations (n = 5)

- 5.2.6 Calculate the relative standard deviation for the individual RF values from the mean for each analyte from the equation

$$RSD_x = \sqrt{\frac{\sum_{i=1}^n (RF_{xi} - RF_{xm})^2}{n-1}}$$

where,

$RSD_x$  = The relative standard deviation of the relative response factor for compound "x"

$RF_{xi}$  = The response factor for compound "x" at concentration "i"

$RF_{xm}$  = The mean response factor for comp. "x"

n = The number of determinations (n=5)

- 5.2.7 Calculate the %RSD<sub>x</sub> for each compound from the equation

$$\%RSD_x = 100 \times \frac{RSD_x}{RF_{xm}}$$

- 5.2.8 Calculate the mean retention time for each compound from the equation

$$RT_{xm} = \frac{\sum_{i=1}^n RT_{xi}}{n}$$

where,

$RT_{xm}$  = The mean retention time of compound "x"

$RT_{xi}$  = The retention time of compound "x" in standard "i"

n = The number of measurements taken (n=5)

- 5.2.9 Calculate the standard deviation of the individual retention times from the mean

$$S_t = \sqrt{\frac{\sum_{i=1}^n (RT_{xi} - RT_{xm})^2}{n-1}}$$

- 5.2.10 Calculate a retention time acceptance window for each compound from the equation

$$RT_{xm} - 3S_t < RRT_x < RT_{xm} + 3S_t$$

5.2.11 Repeat the analysis with the secondary column in place.

### 5.3 Initial Calibration Acceptance Criteria

5.3.1 The %RSD for the response factors must be no greater than 20.

5.3.2 The retention times of each compound in the standards must be within the acceptance window defined in Step 5.2.10.

5.3.3 The same requirements apply to the analysis on the secondary column.

## 6.0 SAMPLE ANALYSIS AND CONTINUING CALIBRATION

6.1 Obtain from the Sample Management Group a batch of samples, consisting of 20 or fewer samples, for analysis. The samples must be of the same matrix (i.e., water, low level soil, or medium level soil), and designated for the same analysis. The batch of samples should include a storage blank.

The storage blank is a sample of laboratory reagent water which the Sample Management Group placed in the appropriate vial into storage at the same time that the samples were placed in storage. There should be one storage blank per 20 samples, or less, if the shipment contained fewer samples.

Allow all the samples to reach room temperature before measuring any aliquots out of the vials.

6.2 Verify that all the samples are within the holding time of 14 days from the date of sampling.

6.3 Verify that the GC is operating on a currently valid initial calibration.

6.4 Make sure that the purge and trap device is set to run at the proper purge temperature for the samples.

6.5 Arrange the samples to be run, each spiked with 10 uL of the working matrix spike solution, in the following sequence:

Run No.	Sample
1	Continuing Calibration Check (CCC), Section 4.2.9
2	Method Blank (MB), Section 5.2.1
3	Storage blank
4	Sample 1*
5	Sample 1*MS
6	Sample 1*MSD
7 - 12	Additional samples up to 12 hours from the start of the CCC
13	CCC
14	MB
15 - 24	Additional samples up to 12 hours from the start of the last
	CCC
25	CCC

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Each 12 hour period must start with a continuing calibration check, and a method blank. The only exception to this is if the sample sequence is started immediately after an initial calibration determination has been performed,.

Each sequence of samples, however long the sequence may be, must end with a continuing calibration check, so that all sample runs are bracketed by valid CCC runs.

Sample 1 in the above sequence has been designated as the sample on which the matrix spike and the duplicate matrix spike will be performed. The sample is inserted early in the sequence, so that the sequence may be aborted if problems arise in the performance of MS/MSD.

- 6.6 For water samples, and associated blanks, the following steps must be taken to set up the samples for analysis. In all cases, the aliquots are removed using gas tight syringe, and the addition of spiking solutions is done through the valve bore directly into the gas tight syringe. If it is anticipated that dilutions may have to be made, it is necessary to remove two aliquots at the same time, since once the sample vial is open the validity of the sample remains only for a very brief period of time. Hence, if dilutions may be required, load two gas tight syringes at the same time and close the syringe valves. The sample in the syringe may be maintained for up to 24 hours.

6.6.1 Check the instrument performance using the CCC

6.6.2 Into the first purge tube add 5.0 mL of the continuing calibration check, prepared as described Section 4.2.7. Add 10 uL of the working matrix spike solution

6.6.3 Into the second purge tube, add 5.0 mL of laboratory reagent water. Using a syringe, add 10 uL of the working matrix spike solution. This solution is the method blank.

6.6.4 Into the third purge tube, add 5.0 mL of the storage blank. Using a syringe, add 10 uL of the working matrix spike solution.

6.6.5 Into each of the remaining purge tubes, add 5.0 mL aliquot of sample. Add to each 10 uL of the working matrix spike solution.

6.6.6 From each sample, after the analytical aliquot has been removed, place a drop or two of the sample on a wide range pH paper and record the pH.

6.6.7 The batch is now ready for analysis.

6.6.8 If dilutions were deemed necessary, the following steps must be taken.

6.6.8.1 Either on the basis of the first analytical run on the sample or on the basis of a screening analysis, determine the dilution ratio that would be required.

6.6.8.2 Take a volumetric flask of the appropriate volume, so that the required sample aliquot would be no less than 1 mL.

- 6.6.8.3 Add to the volumetric flask slightly less than the volume of laboratory reagent water that would be required to make the dilution.
- 6.6.8.4 From the gas tight syringe, add the exact amount of sample aliquot that is necessary. The aliquot must be no less than 1 mL.
- 6.6.8.5 Dilute to the mark with laboratory reagent water. Stopper the flask, and invert three times to mix the solution.
- 6.6.8.6 Treat the diluted sample as a new sample for the purposes of spiking with matrix spike solution.
- 6.6.8.7 If the dilution was an intermediate dilution step, repeat the dilution process on the diluted sample.

## 7.0 SAMPLE ANALYSIS AND CONTINUING CALIBRATION ACCEPTANCE CRITERIA

- 7.1 All sample analyses must be bracketed by an acceptable continuing calibration check.
- 7.2 Continuing calibration check (CCC) acceptance criteria
  - 7.2.1 Calculate the RF for each compound in the CCC as shown in Section 5.2.4.
  - 7.2.2 Calculate the percent difference of the RF as determined in the CCC from the  $RF_m$  determined during the initial calibration, using the equation

$$\%D = 100 \times \frac{|RF_{xc} - RF_{xm}|}{RF_{xm}}$$

where,

$RF_{xc}$  = The RF of compound "x" as determined during CCC run

$RF_{xm}$  = The mean RF of compound "x" as determined during the initial calibration runs

- 7.2.3 %D for the continuing calibration must be no greater than 20.
  - 7.2.4 Determine if the retention time for each analyte falls within the retention time acceptance window as defined in step 5.2.10
- 7.3 Sample analysis initial acceptance criteria
  - 7.3.1 Tentatively identify the target analytes in the sample on the basis of the retention times, as obtained on the primary column.
  - 7.3.2 Confirm the identity of target analytes by the presence of peak in the appropriate retention time window on the secondary column.
  - 7.3.3 Confirm that the spiked compounds are present.

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## 8.0 CALCULATIONS

- 8.1 Calculate the concentration of each compound that has been confirmed through the secondary column analysis using the equation:

$$C = \frac{A}{RF} \times DF$$

Where,

C is the concentration of the identified compound in ug/L

A is the signal area corresponding to the compound

RF is the response factor of the compound as measured in the preceding CCC, in units of area per ug/L

- 8.2 Calculate the percent recovery of the spiked compounds from the equation

$$\%R = 100 \times \frac{C_f}{C_a}$$

where,

C<sub>f</sub> = Concentration of each compound as found by analysis, calculated according to the directions of Step 8.1

C<sub>a</sub> = Concentration of each compound added to the sample.

### 8.3 Quantitative Acceptance Criteria

#### 8.3.1 Method Blank

8.3.1.1 If any target analyte except dichloromethane, appears to be present in the method blank, its concentration must be no greater than the reporting limit as listed in Table 1.

8.3.1.2 If dichloromethane is observed in the method blank, its concentration must not exceed 5X the reporting limit.

#### 8.3.2 Sample Analysis

8.3.2.1 If any target analyte appears in the sample analysis at a concentration higher than the highest standard of the initial calibration curve, the sample must be diluted and reanalyzed. Use the results of the first run to estimate the necessary dilution so that the analyte with the high concentration falls in the upper half of the initial calibration curve.

8.3.3 The matrix spiking compounds recoveries must be within the windows shown below

## Percent Recovery Window Limits for Matrix Spikes

Compound	Water %R
Bromochloromethane	82 - 116
1-Bromo-2-chloropropane	80 - 116
1,4-Dichlorobutane	78 - 121

**9.0 QA/QC REQUIREMENTS****9.1 Initial Calibration Curve**

An initial calibration curve must be run whenever the continuing calibration run is out of control or when corrective action has been taken which may affect the initial calibration.

**9.2 Continuing Calibration Check**

The continuing calibration check (CCC) must be performed at the beginning of each working day and every 12 hours thereafter.

A CCC must also be run at the conclusion of a sequence of analyses, so that all analyzed samples are bracketed by acceptable CCCs. If another batch of samples, from a different sequence is followed, the concluding CCC of one sequence may serve as the opening CCC of the new sequence.

**9.4 Method Blank**

A method blank must be run at least once in every 12 hours period immediately following the continuing calibration run, and prior to any sample run.

If a sample shows target analytes that are suspected to be carry-over from a previous analysis, or suspected of being due to contamination of the system, the sample should be reanalyzed after an acceptable method blank has been run.

**9.5 Storage Blank**

A storage blank is laboratory reagent water contained in a volatiles vial, and prepared by the Sample Management Group at the time of processing, that is placed in the storage area with every batch of samples, consisting of 20 or fewer samples. The storage blank must be analyzed with its associated batch of samples. It serves to warn the analyst of any potential problems associated with solvent migration and cross-contamination which may occur while the samples are in storage.

**9.6 Matrix Spike and Duplicate Matrix Spike**

MS/MSD must be prepared and analyzed at least once for each case, or for every set of 20 samples within the case, or for each group of field samples of similar concentrations

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in soils only, or every 14 calendar days during which samples in a case are received. The choice is made so as to maximize the frequency of running MS/MSD.

## **10.0 CORRECTIVE ACTION**

- 10.1 If the initial calibration curve does not meet the acceptance criteria, first check the preparation of the standards to make sure that no mistakes were made in the preparation step. If the preparation appears to have been acceptable, adjust the GC parameters (temperature program, carrier gas flow rate) to maximize resolution and sensitivity.

Examine the column, injection port and purge system to make sure that the problem is not due to contamination or active sites in those parts of the system.

After the problem has been identified and corrected, rerun the initial calibration curve. No sample analysis may be undertaken without a valid initial calibration curve.

- 10.3 If the continuing calibration does not meet the acceptance criteria, stop the analytical sequence and repeat the analysis of a freshly prepared continuing calibration check. If the second run of the CCC also does not meet the acceptance criteria, identify and correct the problem before performing any additional analyses. After the problem has been corrected, rerun a CCC, then repeat the analyses of those samples that have been analyzed since the last acceptable CCC.

Sample analyses must be bracketed by acceptable CCCs.

- 10.4 If the method blank does not meet the acceptance criteria, run a second aliquot of the method blank. If the second aliquot meets the criteria, contamination of the analytical system was the source of unacceptable initial results. The analytical sequence may be continued, after the successful repeat of the method blank.

If the repeat run of the method blank was still unacceptable, contamination in the sample preparation is the probable source of problem. The entire batch of samples associated with the method blank must be freshly prepared and reanalyzed.

- 10.5 If the sample analysis does not meet the acceptance criteria, run a second aliquot of the sample. If the second aliquot does not meet the acceptance criteria, check all the sample preparation steps and calculations to make sure no errors are being made.

If the calculations and sample preparation appear to be in order, prepare new spiking solutions and prepare a new aliquot of the sample with the new spiking solution. If analysis of the newly prepared aliquot is still not in conformance, the effect may be due to the sample matrix. Report the results, identify the problems in the narrative of the report, and continue with the analysis of further samples.

- 10.6 The recovery limits for MS/MSD are currently advisory only. If these limits are not met, repeat the analysis using a freshly prepared MS and MSD. If the limits are still not met, report the results and proceed with additional sample analyses.

The MS and MSD are prepared in undiluted samples, and without taking into account at the time of preparation what level of the spiking compounds are native to the sample. Thus, it is entirely possible that the recoveries of the MS and MSD cannot be measured with any certainty. If the added concentration due to the spike is less than or equal to 20% of the native amount in the sample, the experimental error is such that the

recovery calculated is highly uncertain. While the results are reported, the values should be flagged and discussed in the narrative.

- 10.7 The matrix spiking compounds recovery limits shown must be met in the method blank for each of the compounds. If they are not met, repeat the analysis. If they are still not met, the entire batch of samples associated with the method blank must be prepared anew. Check the SMC spiking solution before using it for the new preparation.

## **11.0 DOCUMENTATION AND REPORTING**

### **11.1 Internal Documentation**

The analyst will complete the GC autosampler log form for each sample, recording the following information:

- a. Analyst name and date of analysis
- b. Supervisor initials and date checked
- c. Instrument identification
- d. GC column identification
- e. Lab job number
- f. Client name
- g. Analysis type
- h. Method
- i. Lab sample identification for each sample
- j. Computer file name under which data will be sorted
- k. Run sequence
- l. Sample size for each sample
- m. Sample matrix
- n. Identification of spiking solutions
- o. Dilution factors
- p. Time of run for each sample

The GC Department supervisor or his/her designee shall approve the autosampler log. The department supervisor will make enough copies of the log form to file one with each work order (job) from which samples are included in the batch, and keep one copy on record for the department.